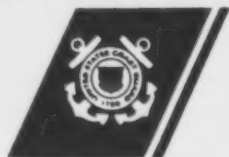


N 22/7/ch. 1-5
N 22/7

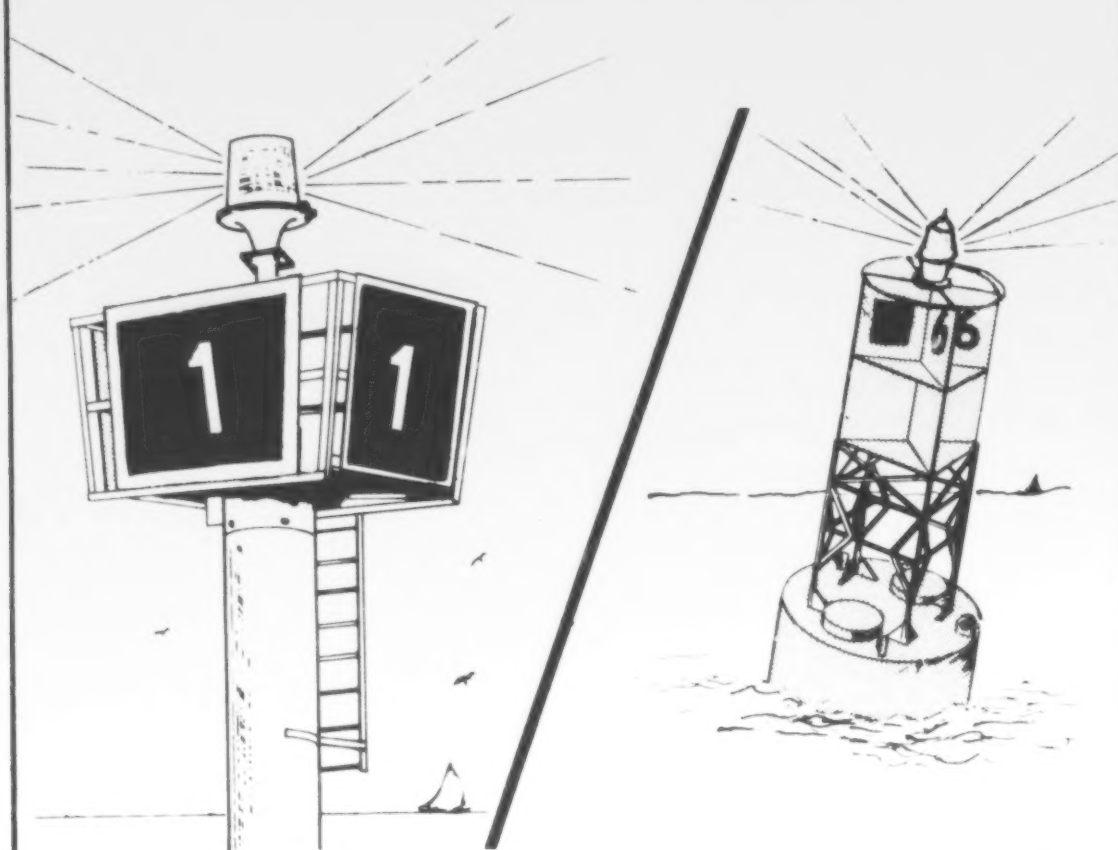
DEPARTMENT OF TRANSPORTATION



COAST GUARD

AIDS TO NAVIGATION TECHNICAL

(INCLUDING CHANGES 1 THROUGH 5)



COMDTINST. M16500.3 (OLD CG-222-3)

U.S. Department
of Transportation

United States
Coast Guard



Commandant
United States Coast Guard

MAILING ADDRESS
COMMANDANT (G-EOE)
U.S. COAST GUARD
WASHINGTON, D.C. 20593
(202) 426-1102

COMDTNOTE 16500

24 JUN 1985

COMMANDANT NOTICE 16500

CANCELLED: 23 DEC 1985

Subj: CH-5 to Commandant Instruction M16500.3, Aids to Navigation
Manual-Technical

1. PURPOSE. This notice provides changes to the Aids to Navigation Manual.
2. SUMMARY OF CHANGES. Significant changes are marked by a vertical line in the left margin. Editorial changes are not marked. The following is a summary of the significant changes:
 - a. Chapter 3: This entire chapter has been revised. Green replaces black as a color for buoys. Cardinal, anchorage, quarantine anchorage, fish net, dredge, and wreck buoys have been deleted. Spherical safe water buoys, special aid buoys, and information and regulatory buoys have been added. Munsell chip notation is used to specify the colors red, green, and yellow. The names of buoys have been changed to agree with recommendations by the International Association of Lighthouse Authorities.
 - b. Chapter 6: Information on the DCB-10 optic and the 500 watt lamp has been deleted. Information on the FA 251-AC optic and the 150 watt lamp has been added.
3. ACTION. District commanders and unit commanding officers shall ensure that the required page replacements and changes are made for Change 5. The change consists of 66 replacement pages and 4 pen and ink corrections.
 - a. Make the following pen and ink changes:
 - (1) On page 6-13, under the column labeled "DCB-24", delete all references to the 500 watt lamp.

DISTRIBUTION - SDL No. 121

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z
A	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2							
B		4	12		12	4	60		20	3				3	1						1					
C		2	2	3		3	1	1	1	1	3	1		3	1		1	1				1	2	1		1
D	1			1																						1
E															1											
F	1	1																								
G																										
H																										

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COMDTNOTE 16500

24 JUN 1985

- 3.a. (2) On page 6-15, "Table 6-6", delete all entries for the 120 volt, 500 watt optic.
- (3) On page 6-91, under "Related Equipment" add the following "3. with bracket provided, the lampchanger unit fits into the FA-251-AC."
- (4) On page 7-12, figure 7-7, "Note", delete the words "to the drivers."

b. Remove and insert the following pages:

REMOVE

Pages i to x
Pages 3-1 to 3-39
Pages 6-1 to 6-2
Pages 6-5 to 6-6
Pages 6-23 to 6-24
Pages 6-29 to 6-30
Pages 6-31 to 6-32
Pages 6-35 to 6-36
Pages 6-41 to 6-46
Pages 6-49 to 6-50
Pages 6-79 to 6-84
Pages 9-23 to 9-24
Pages 9-49 to 9-50

INSERT

Pages i to xiii, CH-5
Pages 3-1 to 3-23 CH-5
Pages 6-1 to 6-2 CH-5
Pages 6-5 to 6-6 CH-5
Pages 6-23 to 6-24 CH-5
Pages 6-29 to 6-30 CH-5
Pages 6-31 to 6-32 CH-5
Pages 6-35 to 6-36 CH-5
Pages 6-41 to 6-46 CH-5
Pages 6-49 to 6-50 CH-5
Pages 6-79 to 6-84 CH-5
Pages 9-23 to 9-24 CH-5
Pages 9-49 to 9-50 CH-5

4. Units that have not received COMDTINST M16500.3, but have received Change 5, may request a copy of COMDTINST M16500.3 from the DOT warehouse in accordance with COMDTNOTE 5600, Directives, Publications and Reports Index.



A. G. FIDAN

Chief, Office of Engineering

Encl: (1) CH-5 to COMDTINST M16500.3

U.S. Department
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COMDTNOTE 16500
17 DEC 1984

COMMANDANT NOTICE 16500

CANCELLED:

10 JUN 1985

Subj: CH-4 TO COMMANDANT INSTRUCTION M16500.3

1. PURPOSE. To publish changes to the Aids to Navigation Manual-Technical, COMDTINST M16500.3.
2. SUMMARY: Change 4 updates the subject manual with recent modifications and equipment changes related to the aids to navigation field including a new chapter on solar powered aids to navigation.
3. ACTION. District commanders and unit commanding officers shall ensure that the required page replacements and changes are made for Change 4. The change consists of 39 additional pages and one replacement page.

a. Remove and insert the following printed page:

REMOVE

9-35

INSERT

9-35

b. Add the following pages: 10-1 thru 10-39

4. Units that have not received COMDTINST M16500.3, but have received CH-4 may requisition a copy of COMDTINST M16500.3 from the DOT warehouse in accordance with COMDTNOTE 5600, Directives, Publications Report Index.

D. L. HOFFER

Acting Chief, Office of Engineering

Encl: (1) CH-4 to COMDTINST M16500.3

DISTRIBUTION - SDL No. 120

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z
A	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2							
B		4	12		12	4	60		20	3					3	1					1					
C		2	2	3		3	1	1	1	1	3	1		3	1			1	1			1	2	1		1
D	1			1																						1
E															1											
F	1	1																								
G																										
H																										

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* COMDTNOTE 16500
8 NOV 1983

COMMANDANT NOTICE 16500

CANCELLED: 7 MAY 1984

Subj: CH-3 to Commandant Instruction M16500.3

1. PURPOSE. To publish changes to the Aids to Navigation Manual-Technical, COMDTINST M16500.3.
2. SUMMARY. Change 3 updates the subject manual with the most recent modifications and available equipment related to the aids to navigation field.
3. ACTION. District commanders and unit commanding officers shall ensure that the required page replacements and changes are made for Change 3. The change consists of 7 pen and ink corrections and 52 replacement pages.
 - a. Pen and ink changes:
 - (1) Page 3-35, write "WR" in the upper left hand quadrant of the radar reflector on each of the 3 example wreck markers.
 - (2) Page 6-40, delete the block starting with "Bird guard".
 - (3) Page 6-42, section "lampchanger bracket" delete the block stating, "A flat bracket is used on the tripod" and ink in an "X" under the 300mm lantern in the block stating, "The bracket valley should be..."
 - (4) Page 6-68, section "features" change "green or red acrylic lenses" to "green, red or yellow acrylic lenses."
 - (5) Page 6-88, delete the sentence "Spare parts are available from the manufacturers."

DISTRIBUTION - SDL No. 118

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z
A	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2		u	v	w	x	y	z
B		4	12		12	4	60		20	3					3	1										
C		2	2	3		3	1	1	1	1	3	1		3	1			1	1			1	2	1		1
D	1			1																						
E															1											1
F	1	1																								
G																										
H																										

NON-STANDARD DISTRIBUTION:

8 NOV 1983

- (6) Page 7-23, change "Table 7-8" to "Table 7-9".
- (7) Page 7-37, change the caption under the photo that reads "ELG-500/02 Emitter" to "ELU-500/02 Emitter".

b. Remove and insert the following printed pages:

REMOVE

i and ii
v thru x
2-3 and 2-4
2-107 thru 2-110
2-127
5-5 and 5-6

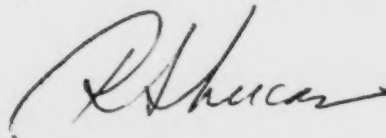
6-17 thru 6-20
6-33 and 6-34
6-36A thru 6-36C
6-47 and 6-48
6-51 and 6-52
6-55 thru 6-64A
6-69 thru 6-72
6-75 thru 6-78
6-83 and 6-84
6-89 thru 6-91
7-21 and 7-22
7-47 and 7-48
9-5 thru 9-12
9-19 thru 9-23

9-45 and 9-46
I-1 thru I-5

INSERT

i and ii
v thru x
2-3 and 2-4
2-107 thru 2-110
2-127 and 2-128
5-5 and 5-6
5-33 thru 5-43
6-17 thru 6-20
6-33 and 6-34
6-36A thru 6-36D
6-47 and 6-48
6-51 and 6-52
6-55 thru 6-64A
6-69 thru 6-72
6-75 thru 6-78
6-83 and 6-84
6-89 thru 6-92
7-21 and 7-22
7-47 and 7-48
9-5 thru 9-12
9-19 thru 9-23
9-40A thru 9-40F
9-45 and 9-46
I-1 thru I-5

Units that have not received COMDTINST M16500.3, but have received CH-3 may requisition a copy of COMDTINST M16500.3 from the DOT warehouse in accordance with COMDTNOTE 5600, Directives, Publications Report Index.



Encl: (1) CH-3 to COMDTINST M16500.3

Chief, Office of Publications



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• COMDTNOTE 16500
27 MAY 1981
CANCELLED: 1 November 1981

• COMMANDANT NOTICE 16500

Subj: CH-2 to COMDTINST M16500.3

1. PURPOSE. To publish changes to the Aids to Navigation Manual, COMDTINST M16500.3.
2. SUMMARY. Change 2 updates the subject manual with the most recent modifications and available equipment related to the aids to navigation field.
3. ACTION. District commanders and unit commanding officers shall ensure that the required page replacements and changes are made for Change 2. The change consists of 15 pen and ink corrections and 7 replacement pages:

a. Pen and ink changes:

- (1) Page ii, insert the following:
"2-D(61) Bird Springs 2-126" after entry
2-D(60).
- (2) Page v, insert the following:
"6-D(17) Standard ATON Voltmeter 6-91" after
the 6-D(16) entry.
- (3) Page 2-3, Table 2-1, for the 3-1/2x8 LR buoy, change
the bridle size from 7/8"x12' to read 7/8"x10'.
- (4) Page 2-9, under Used Buoys-Lighted, paragraph 1,
insert after the last line the following:

"- bird springs (if installed)".
- (5) Page 2-11, paragraph f.(1), line 7, change "5" to
read "3", line 10, Change "7" to read "5".

DISTRIBUTION - SDL No. 113

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z
A	1		1	1	1	1		1	1	1	1	1	2	2	2	2	2	2	2							
B		4	12		12	4	20		2	3					3											
C		2		3		3	1	1	1	1	3	1		3				1	1			1	2	1		1
D	1			1															2							1
E																										
F	1	1																								
G																										
H																										

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COMDTNOTE 16500

27 MAY 1981

3a.(6) Page 2-11, paragraph f.(2), line 6, change "5" to read "3".

(7) Page 2-11, paragraph f.(3), line 1, change "5" to read "3".

(8) Page 2-15, paragraph "Wiring", line 5, change "can" to read "shall".

(9) Page 2-15, paragraph "Buoy Pockets" line 10 (last line), change "2-11" to read "2-10".

(10) Page 2-102, Figure 2-87, for Gong No. 1, change "70 lb" to read "60 lb"; for Gong No. 3, change "80 lb" to read "70 lb"; for Gong No. 4, change "85 lb" to read "75 lb".

(11) Page 2-121, Figure 2-103, change dimension R for Special Split Key from "1/4" to read "3/16"; change dimension W for Special Split Key from "1/2" to read "3/8"; change dimension X for Special Split Key from "4-1/2" to read "5".

(12) Page 6-36B, Figure 6-25(d), for the Monitored Mode Wiring diagram, change "2TB1-1" to read "2TB2-1".

(13) Page 6-53, Table 6-12, correct the listed National Stock Numbers (NSN) to read as follows:

Sensor Type	NSN
C	5961-01-031-8858
R	5961-01-045-5470
B	5961-00-G00-2880
L	5961-00-034-6058

(14) Page 6-56, under Additional Data, correct the listed NSN's for the 155mm lenses to read as follows:

155mm Lantern

Clear lens	6210-00-G00-2288
Green lens	6210-01-029-4173
Red lens	6210-01-029-4174

(15) Page I-5, under letter "v", insert under line 4 ("visual range, 2-6") the following entry "voltmeter, 6-91".

COMDTNOTE 16500

27 MAY 1981

3b. Remove and insert the following printed pages:

<u>Remove</u>	<u>Insert</u>
2-103	2-103
2-105	2-105
2-117	2-117
2-125	2-125
	2-127
	6-91
	I-1

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[Handwritten signature]
200 000 000 000

Encl: (1) CH-2 to COMDTINST M16500.3



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COMDTNOTE 16500
20 AUG 1980

Cancelled: 20 FEB 1981

COMMANDANT NOTICE 16500

Subj: CH-1 to COMDTINST M16500.3

1. PURPOSE. To publish changes to the Aids to Navigation Manual, COMDTINST M16500.3.
2. ACTION. District commanders and unit commanding officers shall make the following changes to COMDTINST M16500.3:

Remove the following pages

table of contents page v

6-5
6-6
6-13
6-14
6-15
6-16
6-80
6-81

index page I-3

Insert the following new and revised pages

table of contents page V, CH-1

6-5, CH-1
6-6, CH-1
6-13, CH-1
6-14, CH-1
6-15, CH-1
6-16, CH-1
6-80, CH-1
6-81, CH-1

index page I-3, CH-1

6-36A, CH-1
6-36B, CH-1
6-36C, CH-1
6-60A, CH-1
6-64A, CH-1
6-89, CH-1
6-90, CH-1

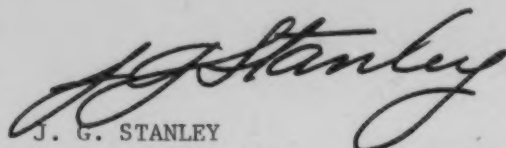
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	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z
A	1		1	1	1	1		1	1	1	1	1	2	2	2	2	2	2								
B		4	60		12	4	60		2	3					3											
C				3		3	1	1	1	1	3	1		3				1	1			1	2	1		1
D	1			1																						1
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F	1		1																							
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COMDTNOTE 16500
20 AUG 1980

2.(cont'd) Units that have not received COMDTINST 16500.3, but have received CH-1 may requisition a copy of COMDTINST 16500.3 from COMDT (G-CMA).



J. G. STANLEY
Acting Chief, Office of Engineering

Encl: (1) CH-1 to COMDT INST M16500.3



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COMDTINST M16500.3
11 SEP 1979

COMMANDANT INSTRUCTION M16500.3 (old CG-222-3)

Subj: Aids to Navigation - Technical

1. PURPOSE. This Manual Instruction contains the instructions and policies governing the selection, installation and maintenance of equipment for the Short Range Aids to Navigation Program.
2. DIRECTIVES AFFECTED. The Aids to Navigation Manual - Technical, CG-222-3 (1975 edition), and Chapters 4, 5, 6, and 8 of Aids to Navigation Manual, CG-222 (1964 edition) are hereby cancelled.
3. ACTION. District Commanders and unit Commanding Officers shall ensure that the provisions of this Instruction are followed.
4. CHANGES. Recommendations for improvements to this instruction shall be submitted to Commandant (G-EOE).

D. C. THOMPSON
Chief, Office of Engineering

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	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z
A	1		1	1	1	1		1	1	1	1	1	2	2	2	2	2	2								
B		4	12		3	4	60			3					3	1							2			
C				3		3	1	1	1	1	3	1		3				1	1			1		1		1
D	1			1																						1
E																										
F	1	1																								
G																										
H																										

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CHAPTER 1 INTRODUCTION

1. PURPOSE.

The purpose of this volume of the Aids to Navigation Manual is to provide the technical information needed to establish and maintain the Short Range Aids to Navigation System of the United States. This information establishes, in measurable terms, those technical objectives and standards necessary for Aids to Navigation equipment to function to its design capability and reliability.

2. CONTENT.

This volume contains the instructions and policies governing the selection, installation and maintenance of equipment for the Short Range Aids to Navigation (AN) program. This volume describes the required end result and does *not* contain step-by-step servicing or maintenance procedures, troubleshooting charts, or check lists to be employed by the servicing personnel. It tells *what* services are to be done and to *what* standard--not *how* these services will be performed. "How to" information is obtained through training, either at the A to N School or by district training teams.

This volume generally covers only that equipment approved by the Commandant for new installations. Very little coverage is devoted to equipment no longer in production but which may still be in use. Technical manuals, manufacturer's literature or publications, and "as built" drawings are generally the only sources of information on this equipment.

3. FORMAT.

This volume is organized into chapters, each dealing with a category of equipment. Each chapter is arranged into the following sections:

A. Selection Guide. These guides vary between the categories of equipment. Where possible a tabular arrangement of operational requirements or constraints versus available equipment is presented. Given the operational requirement, the technical manager will use these guides to select the proper equipment.

Since there are separate chapters on buoys and structures, the selection between these aids is based upon the guidance given in CG-222-1, Chapter 4-2. The primary basis of selection is one of economics--preferring the lower life cycle cost. However, the final decision must be based upon the cost-to-benefit ratio. Thus in selecting an aid for any site, a higher benefit (maintenance of a permanent position, use as marker to position floating aids, etc.) may offset a higher cost.

B. Preparation and Installation. This section is primarily for the servicing personnel. Where possible other documents such as installation manuals are referenced but not repeated. Where other documentation is not available, such as for buoys, it is provided here.

C. Inspection, Maintenance and Repair. This section is for both maintenance and technical personnel. It provides the standards for both the maintenance force doing the work and for the technical force performing inspections. Both required servicing intervals and maintenance standards are provided.

D. Data Sheets. There are data sheets for each individual item in the A to N equipment inventory. Each sheet is self-contained and provides for each item a complete summary of the function, salient features, technical characteristics, physical dimensions and source of supply.

CHAPTER 2 BUOYS AND MOORINGS

This chapter describes buoys, moorings, and related equipment as components of the Coast Guard's aids to navigation system.

Lighted buoys and unlighted sound buoys are classified according to:

- diameter and overall length (ft)
- lighted or unlighted
- sound signal type, if any
- ice buoy, if applicable
- radar reflector, if applicable.

The following abbreviations are used only when designating a lighted buoy or an unlighted sound buoy that is so equipped: lighted (L), bell (B), gong (G), whistle (W), electric bell striker (E), horn (H), ice buoy (I), and radar reflector (R).

Unlighted buoys, excluding unlighted sound buoys, are classified according to:

- class
- CAN or NUN
- construction material (other than steel)

- special or tall
- radar reflector, if applicable.

The following abbreviations are used only when designating an unlighted buoy that is so equipped: CAN (C), NUN (N), tall (T), special (S), plastic (P), aluminum (A), and radar reflector (R). Exceptions to these rules (with the appropriate abbreviation in parentheses) are mooring buoys (M), drum or barrel buoys (D), spar buoys (SPAR), and fast-water buoys (F).

Steel buoys now approved for manufacture are designated as standard. Buoys with operational characteristics identical to those currently authorized for manufacture are also considered standard. Although nonstandard buoys are obsolete, their continued use is authorized. Of plastic buoys, only the small fifth and sixth class are approved for manufacture. They are considered standard, but are not designed to totally replace steel buoys of a similar size, particularly in locations subjected to ice.

A. SELECTION GUIDE

Introduction. No single type of buoy can satisfy all the requirements of the various locations where floating aids to navigation are needed. For this reason, there are several types of buoys--classified as suitable for exposed, semiexposed, or protected conditions, as defined in Volume 1 of this manual (CG-222-1). In selecting a buoy type, however, all of the following conditions must be considered.

Fetch. Fetch is the length of the stretch of water over which the wind acts on the sea surface from the same direction. For a given wind speed, the longer the fetch, the greater the sea disturbance. Fetch is characterized as exposed (a large fetch, with little or no protection from land masses), semiexposed (a medium fetch, with some protection from land masses), or protected (little or no fetch, with locations sheltered by land, harbors, rivers, or small bays).

Wind Strength. Wind strength is the severity of the prevailing winds at a specified location. Wind conditions are not unique to any one type of station (exposed, semiexposed, or protected) and must be combined with fetch when selecting a type of buoy.

Wave Action. Wind speed, fetch, water depth, wave height, and wave period contribute to wave action. For a given wind speed, the larger the fetch, the larger the wave height, and the longer the wave period (the time interval between passage of successive wave crests). In general, then, the size of the wave and the length of the wave period are determined by the amount of exposure.

Mooring Depth

Current

Other selection factors, such as visible distance, sound signals, and location of servicing facilities, are covered in other sections of this manual.

Characteristics of Standard Buoys (Tables 2-1, 2-3, and 2-5)

Buoy Weight. This is the weight of the buoy without moorings or power units.

Buoy Draft. Buoy draft is the distance from the waterline of the buoy to its lowest underwater part, not including moorings. The values given in the tables and on the data sheets are for buoys without moorings or power units. The draft of a buoy with a chain mooring and power units (for lighted buoys) can be calculated using the pounds-per-inch of immersion (see *Maximum Mooring Depth*, pages 2-7 - 2-8).

Focal Height of Light. The distance from the waterline to the focal plane of the lantern is the focal height of light. The values given in the tables and on the data sheets are for buoys without moorings or power units. The focal height to the lantern for buoys with moorings and power units can be calculated using the pounds-per-inch of immersion (pages 2-7 - 2-8).

Freeboard. For lighted buoys and unlighted sound buoys, freeboard is the distance from the waterline to the deck of the buoy (top dished head). For unlighted buoys, it is the distance from the waterline to the base of the radar reflector. The values given in the tables and on the data sheets are for buoys without moorings or power units. The freeboard of a buoy with a chain mooring and power units can be calculated using the pounds-per-inch of immersion (pages 2-7 - 2-8).

Minimum Freeboard. This is the minimum freeboard recommended for a particular buoy. This freeboard, measured from the deck of the buoy, is required at the buoy's maximum mooring depth to resist current and wave loads.

Pounds-per-Inch of Immersion. This is the force (weight) necessary to submerge the buoy an additional inch. The force can be due to chain, batteries, or ballast balls. For buoys with anything other than straight sides at the waterline

Characteristics of Standard Buoys (cont'd)

the figure supplied is necessarily an average. This value is used in determining draft, freeboard, and focal height of the lantern with different moorings or power units.

Power Units. This refers to the maximum size and number of standard power units that the buoy can accommodate.

Sound Equipment. This refers to the size and type of sound equipment on the buoy.

Bridle Size. Bridle size is the size of the bridle to be used with the buoy. The first number in this column (as shown in Tables 2-1 and 2-3) is the chain size and the second number is the total length of the bridle. Depending on conditions, it may be necessary to change the chain size of the bridle. However, the length should be kept the same to prevent any

chafing of the counterweight tube.

Mooring Chain Size. This is the chain size recommended for use under normal conditions.

Sinker Size. Sinker size is the concrete sinker weight recommended for use under normal conditions.

Operational Characteristics of Standard Buoys (Tables 2-2, 2-4, and 2-6)

Nominal Visual Range of Daymark.

The nominal visual range is that at which you can expect to see the buoy if the visibility is 10 nmi and the contrast between the buoy and background, as well as the observer's height of eye, are the same as assumed and outlined in this section. Table 2-7 provides the nominal visual range

Table 2-1
Characteristics of Standard Lighted Buoys

	BUOY TYPE	9x32				8x26				7x17	6x20		5x11	3 1/2x8
	CHARACTERISTICS	LR	LBR	LGR	LWR	LR	LBR	LGR	LWR	LR	LR	LBR	LR	LR
PHYSICAL CHARACTERISTICS	BUOY WEIGHT (LB)	17,443	19,091	19,391	18,616	11,382	11,917	11,853	12,131	7,810	6,023	6,270	3,004	1,487
	BUOY DRAFT (FT. IN.) NO MOORING	11 9	12 2	12 3	12 11	10 1	10 3	10 3	11 0	5 6	8 7	8 9	4 0	2 9
	FOCAL HEIGHT OF LIGHT (FT. IN.) NO MOORING	20 2	19 9	19 8	19 0	15 10	15 8	15 8	15 0	11 8	10 11	10 9	7 7	5 6
	FREEBOARD (FT. IN.) NO MOORING	4 5	4 0	3 11	3 3	3 3	3 1	3 1	2 4	3 0	2 6	2 4	1 9	1 4
	MINIMUM FREE- BOARD (IN.)	16	16	16	16	15	15	15	15	12	12	12	9	6
	LB PER IN. OF IMMERSION	340	340	340	300	270	270	270	250	205	150	150	105	50
RELATED EQUIPMENT	POWER UNITS (MAX- IMUM NO. & SIZE)	2 B30	2 B30	2 B30	2 B30	2 B30	2 B30	2 B30	2 B30	2 B30	2 B30	2 B30	1 B10	1 B10
	SOUND EQUIPMENT	NONE	1,000 LB BELL	36 IN. GONG	4 BALL WHIS- TLE	NONE	225 LB BELL	20- IN. GONG	4 BALL WHIS- TLE	NONE	NONE	85 LB BELL	NONE	NONE
	BRIDLE SIZE CHAIN DIA. X LENGTH (IN. X FT.)	1 1/2 18	1 1/2 18	1 1/2 18	1 1/2 18	1 1/4 15	1 1/4 15	1 1/4 15	1 1/4 15	1 1/4 15	1 12	1 12	1 12	7/8 10
	MOORING CHAIN SIZE (IN.)	1 1/2	1 1/2	1 1/2	1 1/2	1 1/4	1 1/4	1 1/4	1 1/4	1 1/8	1 1/8	1 1/8	3/4	3/4
	SINKER SIZE (LB)	12,750	12,750	12,750	12,750	8,500	8,500	8,500	8,500	5,000	5,000	5,000	4,000	2,000

Table 2-2
Operational Characteristics of Standard Lighted Buoys

BUOY TYPE		SEMIEXPOSED												
		EXPOSED									PROTECTED			
		9x32				8x26					7x17	6x20		5x11
CHARACTERISTICS		LR	LBR	LGR	LWR	LR	LBR	LGR	LWR	LR	LR	LBR	LR	LR
NOMINAL VISUAL RANGE OF DAYMARK (NMI)		3.8	3.8	3.8	3.8	3.2	3.2	3.2	3.2	2.3	2.1	2.1	1.4	1.4
RADAR RANGE (NMI)		4.5	4.5	4.5	4.5	3.7	3.7	3.7	3.7	2.7	2.4	2.4	1.7	1.3
MAXIMUM CURRENT (KN)		5	5	5	5	4	4	4	4	4	4	4	3	3
MINIMUM MOORING DEPTH (FT)		30	30	30	30	25	25	25	25	15	20	20	10	10
MAXIMUM MOORING DEPTH (FT) (USING RECOMMENDED CHAIN SIZE)	B10A POWER UNITS	345	300	285	180	250	225	220	110	225	110	95	110	30
	B30A POWER UNITS	325	275	265	155	225	190	205	90	200	85	90	—	—

Table 2-3
Characteristics of Standard Unlighted Sound Buoys

BUOY TYPE		8x26	9x20	
CHARACTERISTICS		WR	BR	GR
PHYSICAL CHARACTERISTICS	BUOY WEIGHT (LB)	12,131	8,110	8,110
	BUOY DRAFT (FT-IN.) NO MOORING	10-9	5-5	5-5
	FREEBOARD (FT-IN.) NO MOORING	2-2	2-0	2-0
	MINIMUM FREEBOARD (IN.)	15	9	9
	LB PER IN. OF IMMERSION	250	340	340
	LB PER IN. OF IMMERSION	250	340	340
RELATED EQUIPMENT	SOUND EQUIPMENT	4-BALL WHISTLE	225-LB BELL	320-IN. GONGS
	BRIDLE SIZE CHAIN DIA. X LENGTH (IN.XFT)	1 1/4 15	1 1/4 15	1 1/4 15
	MOORING CHAIN SIZE (IN.)	1 1/4	1 1/4	1 1/4
	SINKER SIZE (LB)	8,500	5,000	5,000

Table 2-4
Operational Characteristics of Standard Unlighted Sound Buoys

BUOY TYPE		EXPOSED		
		8x26	9x20	
CHARACTERISTICS		WR	BR	GR
NOMINAL VISUAL RANGE OF DAYMARK (NMI)		3.2	3.0	3.0
RADAR RANGE (NMI)		3.7	3.7	3.7
MAXIMUM CURRENT (KN)		4	4	4
MINIMUM MOORING DEPTH (FT)		25	15	15
MAXIMUM MOORING DEPTH (FT)		117	200	200

Table 2-5
Characteristics of Standard Unlighted Buoys

BUOY TYPE	PHYSICAL CHARACTERISTICS													
	1	1	2	2	3	3	4	4	5	5	5	5	6	6
CHARACTERISTICS	CR	NR	CR	NR	CR	NR	CR	NR	CR	NR	CR	NR	CT	NT
BUOY WEIGHT (LB)	5,600	5,400	2,700	2,600	955	935	465	470	675	680	150	150	165	170
BUOY DRAFT (FT. IN.) NO MOORING	8-0	7-11	6-1	6-0	4-0	3-11	5-0	5-0	4-10	4-11	4-0	4-0	4-0	4-0
FREEBOARD (FT. IN.) NO MOORING	6-0	6-1	3-11	4-0	2-8	2-9	2-11	2-8	2-6	2-5	0-8	0-8	2-9	4-2
MINIMUM FREEBOARD (FT. IN.)	2-5	2-5	1-0	1-0	0-9	0-9	1-0	1-0	0-6	0-6	0-3	0-3	0-6	0-3
LB PER IN. OF IMMERSION	105	105	67	67	38	38	21	21	16	16	22	22	9	9
MOORING CHAIN SIZE (IN.)	1 1/8	1 1/8	7/8	7/8	3/4	3/4	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
SINKER SIZE (LB)	5,000	5,000	4,000	4,000	3,000	3,000	2,000	2,000	2,000	2,000	500	500	500	500
RELATED EQUIPMENT														

Table 2-6
Operational Characteristics of Standard Unlighted Buoys

BUOY TYPE	SEMIEXPOSED										RIVER									
	EXPOSED					PROTECTED					PROTECTED					PROTECTED				
CHARACTERISTICS	1	2	2	3	3	4	4	5	5	5	5	5	5	5	5	6	6	6	6	6
NOMINAL VISUAL RANGE OF DAYMARK (NMI)	3.8	3.5	2.8	2.6	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.0	1.0	1.0	1.0	1.0
RADAR RANGE (NMI)	3.5	3.5	2.5	3.0	1.5	1.75	1.5	1.5	1.5	1.5	1.25	1.25	1.25	1.0	1.0	0.5	0.5	0.5	0.75	0.75
MAXIMUM CURRENT (KN)	6	6	6	6	5	5	5	5	5	5	3	3	3	3	3	2.5	2.5	2.5	3	3
MINIMUM DEPTH (FT.)	15	15	15	15	10	10	10	10	10	10	6	6	6	6	6	6	6	6	5	5
MAXIMUM DEPTH (FT.)	236	241	200	205	102	107	132	115	105	100	35	35	35	35	35	64	49	35	35	35

Operational Characteristics of Standard Buoys (cont'd)

Table 2-7
Change in Nominal Visual Range of Buoy Types
Versus Change in Visibility (nmi)

VISIBILITY (NMI)	NOMINAL RANGE						
	2.0	2.5	5.0	7.5	10.0	12.5	15.0
BUOY TYPE							
9x32	1.7	2.0	2.8	3.3	3.8	4.0	4.1
8x26	1.5	1.7	2.3	2.6	3.2	3.5	3.8
7x17	1.2	1.5	2.0	2.1	2.3	2.5	2.6
6x20	1.0	1.3	1.8	2.0	2.1	2.3	2.3
5x11	0.9	1.0	1.2	1.4	1.4	1.4	1.4
3½x8	0.8	0.9	1.1	1.2	1.4	1.4	1.4
9x20	1.5	1.7	2.4	2.6	3.0	3.1	3.3
1 CR	1.6	1.8	2.7	3.3	3.8	4.0	4.2
1 NR	1.5	1.7	2.6	3.1	3.5	3.8	4.0
2 CR	1.2	1.3	1.9	2.5	2.8	3.1	3.3
2 NR	1.2	1.3	1.8	2.2	2.6	2.8	2.9
3 CR/NR	0.8	1.0	1.2	1.3	1.4	1.4	1.4
4 CR/NR	0.8	1.0	1.2	1.3	1.4	1.4	1.4
5 CR/NR	0.7	0.8	0.9	0.9	1.0	1.0	1.0
6 CR/NR, 6 CT/NT	0.7	0.8	0.9	0.9	1.0	1.0	1.0
5 CPR/NPR	0.7	0.8	0.9	0.9	1.0	1.0	1.0
6 CPR/NPR	0.4	0.4	0.5	0.5	0.5	0.5	0.6

of the buoy types under different visibility conditions, all other factors remaining unchanged. In all cases, the method used to calculate the nominal visual range makes certain assumptions about the contrast between the buoy and its background. Unlike lights, which are observed against a dark background, a buoy may be seen against sky, sea, or shore, or combinations of these. Also, the color of the buoy will affect its ability to be seen.

For the nominal visual ranges provided on the data sheets and in this section, it is assumed that the buoys are

either red or black and that small buoys with daymark areas of less than 10 sq ft are seen against a sea (dark) background. It is assumed that larger buoys, with daymark areas of 10 sq ft or more, are contrasted against both sea and sky. The amount of the buoy seen against the sky will depend on the height of eye of the observer. The calculations assumed certain contrasts between the buoy and the background and a height of eye of 15 ft. As the observer's height of eye increases, less of the buoy will be seen against the sky background and its range will therefore decrease. This is true for large buoys with daymark areas of 10 sq ft or

Operational Characteristics of Standard Buoys (cont'd)

more. Table 2-8 lists the daymark areas of standard buoys. It is important to note that the nominal visual range of a buoy, as provided in Table 2-7 and on the data sheets, will differ from actual observations, sometimes considerably, when conditions of visibility, aid color, background, or observer's height of eye are different from those values used in the calculations. Incorporation of all these factors is complex and beyond the scope of this section. The nominal visual range values provided are intended to indicate typical distances at which red or black buoys can be seen and how these ranges are affected by changes in visibility.

Table 2-8
Daymark Areas for Standard Buoys

Buoy	Daymark Area (Ft ²)
9X32 LR, LBR, LGR, LWR	53
8X26 LR, LBR, LGR, LWR	37.5
7X17 LR	22.25
6X20 LR, LBR	15
5X11 LR	11
3½X8 LR	8
9X20 BR, GR	30
1 CR	49
1 NR	42.5
2 CR	27
2 NR	22
3 CR	10.25
3 NR	9.25
4 CR	7.9
4 NR	6.6
5 CR	5.6
5 NR	5
5 LPR	5
5 NPR	5
6 CR	4.5
6 NR	4.1
6 CT	4.5
6 NT	4.5
6 CPR	2
6 NPR	2

Radar Range. Radar ranges are calculated from complex theoretical equations that consider not only the radar reflector

configuration of the buoy, but also the characteristics of the radar set. The ranges determined by this theory have been substantiated by field testing. The ranges represent an average range at which a blip/scan ratio of 0.2 is obtained. The stereotype radar set used in determining these ranges has the following characteristics:

- antenna height, 10 ft
- peak transmitted power, 3 kw
- wavelength, 3 cm
- antenna gain, 25 dB
- receiver noise figure, 12 dB
- 1F bandwidth, 10 MHz
- frequency, 9.4 GHz
- noise factor, 16 dB.

Maximum Current. This is the maximum surface current in which the buoy will stand upright with adequate freeboard.

Minimum Mooring Depth. The amount of water needed to float the buoy with its counterweight or chain bridle clear of the bottom is the minimum mooring depth. The values given in the tables and on the data sheets are for mean low water. Local tidal conditions must be considered.

Maximum Mooring Depth. Maximum mooring depth is a function of the chain size used, the allowable minimum freeboard of the buoy, and, with lighted buoys--the size (weight) of the power units used. For lighted buoys, the operational characteristics section on the tables and on each data sheet shows the maximum mooring depth for two power units. Generally, with two-pocket buoys where only one power unit is used, the other pocket is ballasted. Therefore, the figures for a 1000-Ah power unit are valid for a 2000-Ah hookup, as are the 3000-Ah figures for a 6000-Ah hookup. Note that 5X11 LR and 3½X8 LR buoys (Table 2-2 and Data Sheets 2-D(13) and (14)) can only accommodate a 1000-Ah power unit and that only one set of values is supplied. In calculating the maximum mooring depth, a scope of 3 to 1 is used--assuming that two-thirds of the scope is off the bottom and supported by the buoy. For unlighted

Operational Characteristics of Standard Buoys (cont'd)

buoys, the same assumptions are made except that power units are not considered.

As an example, consider an 8X26 LR buoy, with two 1000-Ah power units, that is moored in 90 ft of water with three shots of 1¼-in. chain, using a 15-ft bridle. Assume that under normal conditions, two-thirds of the mooring will be off the bottom. The additional weight the buoy must support is the weight of the batteries and the weight of the mooring. (Note that steel chain weighs 13 percent less in water than in air.) The added weight is calculated as follows:

2 X 245 (battery weight) + (.87)
X 212 (bridle) + (.87)(13.83) (weight
per foot of chain) X 3 (number of
shots) X 90 (length of shot) X 2/3
(percent of mooring suspended in
water) = additional weight

2(245) + (.87)(212) + (.87)(13.83)
(3)(90)(2/3) = 2835 lb.

The immersion factor for the 8X26 LR buoy is 270 lb/in. (from Table 2-1 and Data Sheet 2-D(5)). Dividing the addi-

tional weight calculated above by 270 will give the number of inches the buoy sinks in the water due to the mooring and battery weight ($2835/270 = 10.5$ in.). Using this figure, the buoy's draft, freeboard, and focal height of light can be determined as follows:

Draft	10 ft	1 in.	draft, no mooring
	+	10.5 in.	sinkage
	10 ft	11.5 in.	new draft
Freeboard	3 ft	3 in.	freeboard, no mooring
	-	10.5 in.	sinkage
	2 ft	4.5 in.	new freeboard

Note that the new freeboard is larger than the minimum freeboard, 15 in., shown in Table 2-1 and on Data Sheet 2-D(5).

Focal height of light	15 ft	10 in.	focal height, no mooring
	-	10.5 in.	sinkage
	14 ft	11.5 in.	new focal height of light

B. PREPARATION AND INSTALLATION

Most of this section covers preparation and installation of buoys. The remainder describes preparation and installation of wave-activated sound signals.

Buoys. Preparation and installation operations occur at the depot or base or on the buoy tender (or at the servicing unit). In the text that follows, certain functions are listed as performed by the base or depot, while others are listed as performed by the buoy tender. In some areas, it may be practical to shift these duties somewhat. Since tender costs tend to be fixed (and base costs may be variable), the minimum the base or depot must do to prepare a buoy is listed. If justified by the tender workload, some of the items listed under tender may be shifted to the base or depot.

Depot or Base

• New Buoys--Steel

1. Examine the buoy to insure that all necessary modifications have been incorporated.
2. New buoys will have the wash primer and vinyl red lead primer already applied. Upon receipt, inspect this coating for damage suffered during shipment. Repairs shall be made in accordance with section 4.1.11 of the *Coatings and Color Manual* (CG-263).
3. Apply the top coats in accordance with section 4.1.9 of CG-263. Color and marking shall be as outlined in Chapter 3 of this manual (CG-222-3).
4. If a wave-activated sound signal is required, install the bell, gong, or whistle, and tappers (if necessary). Preparation and installation shall be as outlined on pages 2-13 - 2-14. Electric sound signals are discussed in Chapter 7.
5. Deliver the buoy to the user.

• New Buoys--Plastic. Plastic buoys do not require any preparation by the

depot or base. The buoys shall be removed from their packages and delivered to the user. If the surface coat is damaged, it shall be touched up using standard vinyl top coats with no primer.

• Used Buoys--Lighted

1. After receipt of a used buoy, the following items shall be removed:
 - external wiring and junction box
 - pocket cover(s), gasket(s), and V-band coupling
 - vent valves and reducer
 - damaged tappers (see page 2-14)
 - worn chafing blocks (see page 2-10)
 - sound signal
 - retroreflective material.
 - *bird springs (if installed)*
2. Prior to any abrasive cleaning, the following items shall be covered and protected:
 - pocket flanges and pockets
 - vent-line threads and openings
 - neoprene hinges or tappers not removed
 - swing bolts.
3. Abrasive cleaning shall be performed in accordance with section 4.1.5 of CG-263.
4. Structural Repairs
 - a. Main Buoy Body. Small dents (no more than 2 ft in diameter and 6 in. deep) that do not penetrate the hull are not serious and need not be repaired. Severe dents, larger than the ones just described, shall be repaired--returning the buoy body to approximately its original shape. Leaks in seams or pit holes shall be welded closed using No. 7018, 6011, or 6013 steel electrodes (NSN 3439-00-866-2835). Pit holes deeper than 1/8 in. shall be welded using one of the steel electrodes just cited.
 - b. Mooring Fittings. Mooring eyes with their lower bar worn to the diameters given in Table 2-9 (or less) shall be rebuilt to the original diameter by

Buoys (cont'd)

Table 2-9
Mooring Eye Wear--Lighted Buoys

Buoy	Minimum Bar Size (In.)	Original Bar Size (In.)
9X32	2 3/4	3 3/4 (includes bushing)
8X26	1 5/8	2 1/4
6X20	1 1/8	2

welding or replacement of the sleeve bushing. The filler weld shall be made with No. 7018, 6011, or 6013 steel electrodes. This weld may then be capped with a weld using hard-facing welding rods (NSN 3439-00-262-2637).

Mooring arms bent to within 3 in. of the counterweight shall be straightened. If the mooring hole in the arm is enlarged by more than 3/8 in., it shall be built back up by welding to its original diameter (see Mooring Arms Data Sheet 2-D(51)). The filler weld shall be made with No. 7018, 6011, or 6013 steel electrodes. This weld can then be capped with a weld using hard-facing welding rods (NSN 3439-00-262-2637). If the pin to which the mooring arm is attached to the buoy is worn more than 5/8 in., it shall be replaced (see Data Sheet 2-D(52)).

c. Chafing Blocks. Wood chafing blocks worn to within 3/4 in. of the metal support bars shall be replaced. Any chafing blocks worm-eaten or rotted around two of the through bolts shall be replaced. In all cases, either salt-treated hardwood (white oak) or rubber blocks shall be used.

d. Counterweight Tubes. Bent counterweight tubes shall be straightened or replaced and the weld at the counterweight tube/buoy body junction shall be inspected and welded as necessary. On 1962-type, 8X26 LR buoys, a doubler plate of 2 1/4- by 1/4- by 18-in. steel shall be installed between the gusset plates and the buoy body (if not already done).

e. Battery Pockets. Pocket flanges that have been damaged or dented out of round by more than 1/2 in. in diameter shall be replaced. Any pocket(s) that cannot pass the following air test shall have the flange replaced, except where other causes for the leaks can be found.

(1) After sealing the battery pocket(s), attach a calibrated pressure gauge to one vent line. A gauge range shall be selected such that the test pressure of 1-2 psi is not less than 10 percent of the scale. The instrument shall have a 1 percent accuracy at the test pressure.

(2) The air source used for the test shall be the lowest pressure practicable. A pressure regulator shall be installed in the line. It shall reduce the pressure to not more than 2 psi. A relief valve shall also be provided. It shall automatically relieve pressure when the pressure exceeds 10 psi. The relief valve shall be nonisolable and capable of independently reducing the pocket air pressure more rapidly than it can be increased by the air source. The valves and pressure source shall be located at the other vent line.

(3) A maximum air pressure of 1-2 psi shall be applied to the pocket(s) and observed for 5 min. Any drop in pressure will cause the pocket(s) to fail the test.

(4) A petcock shall be provided to vent off the pressure at the end of the test. If the buoy pockets are tested with the batteries in them, it is necessary to vent off the pressure very slowly to prevent damage to the batteries.

(5) After a successful air test, the pockets and covers should be marked by welding or paint so that the user can later realign the covers on their matching flanges in the same orientation as during the air test.

Buoys (cont'd)

The battery pocket closures on 1965-type, 3½X8 LR and 5X11 LR buoys with V-band pockets shall have a swing-bolt flange added OR shall be modified with four swing bolts in addition to the V-band, as shown in CG Drawing No. 120755 (see Data Sheet 2-D(50)).

On 1942-type, 3½X8, 5X10, 6X20, and 7X15 buoys, which were originally built with open battery pockets, install a rolled steel tube to seal the pocket (if not already done).

f. Air Test for Watertight Integrity of Buoy Hulls. After overhaul, each buoy body shall be subjected to an air test. The following air pressure test procedure shall be followed:

(1) The air source used for the test shall be the lowest pressure practicable, consistent with test pressure requirements. A pressure regulator shall be installed in the line. It shall reduce the pressure to not more than **3** psi. A relief valve shall also be provided. It shall automatically relieve pressure when the air pressure exceeds **5** psi in the buoy body. The relief valve shall be nonisolable and capable of independently reducing the buoy body pressure more rapidly than it can be increased by the air source. Relief valves that have a rapid adjustment feature by which the set point may be inadvertently changed shall NOT be used.

(2) An air pressure gauge shall be used to monitor the pressure within the buoy body. The use of two independent gauges is considered safer. A gauge range shall be selected such that the test pressure of **3** psi is not less than 20 percent of the scale. The instrument shall have at the test pressure a 1 percent accuracy and a 1 oz/in.² sensitivity. The gauges shall have been calibrated for accuracy within 6 mo prior to the test.

(3) An air pressure of **3** psi shall be built up in the buoy body through

the test fitting on the buoy body. Observe the pressure reading for 10 min--any drop in pressure in excess of 1 oz/in.² shall be reason to check the hull for leaks. The air test shall be conducted again after repairs.

(4) A petcock shall be provided to vent off the pressure at the end of the test.

Additional information on safety precautions in air testing is outlined in *Naval Ships Technical Manual*, Chapter 9880, Section IV, as amended on 1 September 1973.

g. Towers. Tower legs or feet broken away from the hull shall be replaced or reconnected by welding. Tower legs bent more than 3 in. from a straight line over a 2-ft length shall be straightened. Any bent leg(s) that causes the tower to appear crooked shall be corrected. The lantern on a buoy floating in dead calm water shall show a beam of light parallel to the water surface. Bent towers, radar reflectors, or lantern base plates should be straightened to provide a "level" surface for the lantern.

Radar reflector plates bent more than 3 degrees from a right angle shall be corrected. Bent or broken guano bars shall be replaced. Radar reflectors should be added to 1942-type and 1928-type buoys whenever the condition of the buoy and available funds permit. Modification shall be made in accordance with CG Drawings No. 107304, 107302, and 107308.

5. Buoys shall be painted in accordance with Chapter 4 of CG-263. Color and marking shall be as outlined in Chapter 3 of this manual (CG-222-3).

6. Battery pocket covers shall be installed on the buoy after the crossover and vent lines have been checked and cleaned of sandblast grit and scale.

7. If a wave-activated sound signal is required, the bell, gong, or whistle, and tappers (if necessary) shall be

Buoys (cont'd)

installed. Preparation and installation shall be as outlined on page 2-14. .
(For electric sound signals, see Chapter 7.)

8. Deliver the buoy to the user.

• Used Buoys--Unlighted

1. An unlighted sound buoy shall have any damaged tapper removed (page 2-14).

2. Prior to abrasive cleaning, the sound signal shall be removed or covered and protected.

3. Abrasive cleaning shall be performed in accordance with section 4.1.5 of CG-263.

4. Structural Repairs

a. Main Buoy Body. Small dents no more than 2 ft in diameter and 6 in. deep that do not penetrate the hull are not serious and need not be repaired. Severe dents, larger than the ones described above, shall be repaired--returning the buoy body to approximately its original shape. Leaks in seams or pit holes shall be welded closed using No. 7018, 6013, or 6011 steel electrodes (NSN 3439-00-866-2853). In riveted buoys, it is best to try to close seam leaks by peening. On first-, second-, and third-class buoys, pit holes deeper than 1/8 in. shall be welded using No. 7018, 6013, or 6011 steel electrodes. On fifth-class buoys, pit holes deeper than 1/16 in. shall be welded using No. 7018, 6013, or 6011 steel electrodes. Pit holes on fourth- and sixth-class buoys need not be repaired.

b. Mooring Fittings. Mooring eyes with their lower bar worn to the diameters given in Table 2-10 (or less) shall be rebuilt to the original diameter by welding. The filler weld shall be made with No. 7018, 6013, or 6011 steel electrodes. This weld may then be capped with a weld using hard-facing welding rods (NSN 3439-00-262-2637). Those buoys that are equipped with mooring pins shall have the mooring pins

replaced when the diameter has been reduced to that shown in Table 2-11.

Table 2-10
Mooring Eye Wear--Unlighted Buoys

Buoy	Minimum Bar Size (In.)	Original Bar Size (In.)
8X26 WR	1 5/8	2 1/4
9X20 BR/GR	1 7/8	2 1/2
1 CR/1 NR	1 1/2	2
2 CR/2 NR	1 5/16	1 3/4
3 CR/3 NR	1 1/8	1 1/2
5 CR/5 NR	1 1/8	1 1/2

Table 2-11
Mooring Pin Wear--Unlighted Buoys

Buoy	Minimum Pin Diameter (In.)	Original Pin Size (In.)
1 CR/1 NR	7/8	1 3/4
2 CR/2 NR	7/8	1 3/4
3 CR/3 NR	5/8	1

Unlighted first-, second-, and third-class buoys with mooring eyes shall have the mooring pin type fittings added in accordance with CG Drawing No. 120099 when the condition of the buoy and available funds permit.

c. Air Test for Watertight Integrity of Buoy Hulls. After overhaul, each first-, second-, third-, and fifth-class buoy shall be subjected to an air test. The air test shall be as outlined on page 2-11 of this chapter.

d. Towers (Unlighted Sound Buoys Only). Tower legs or feet broken away from the hull shall be replaced or reconnected by welding. Tower legs bent more than 3 in. from a straight line

Buoys (cont'd)

over a 2-ft length shall be straightened. Any bent leg(s) that causes the tower to appear crooked shall be corrected. Radar reflector plates bent more than 3 degrees from a right angle shall be corrected.

5. Unlighted buoys shall be painted in accordance with Chapter 4 of CG-263. Color and marking shall be as outlined in Chapter 3 of this manual (CG-222-3).

6. If a wave-activated sound signal is required, the bell, gong, or whistle, and tappers (if necessary) shall be as outlined below. (For electric sound signals, see Chapter 7.)

7. Deliver the buoy to the user.

Tender or Servicing Unit

● Lighted Buoys

1. After receipt of the buoy from the depot or base, the tender or servicing unit shall install the following items:

- lantern and light equipment
- wiring, wiring clips, and stuffing tubes
- power units with power assembly clamp
- vent valves and PVC reducer
- pocket covers and gasket
- bridle, swivel, mooring chain, and sinker
- retroreflective material.

2. Prior to deployment, the following items shall be checked for proper operation:

- lantern package (see Chapter 6)
- vent valves
- pocket closures, using air test as outlined on page 2-11
- tappers for free movement and striking of gong or bell
- mooring arms for free swing
- swivel for free movement.

3. When returning buoys from station, the tender or servicing unit shall remove the following items from the buoy:

- ALL marine growth
- all mooring equipment (bridle, swivel, shackles, etc.)
- power units
- lantern package.

● Unlighted Buoys

1. After receipt of the buoy from the depot or base, the tender or servicing unit shall install retroreflective material (see Chapter 3) and the mooring chain and sinker.

2. Prior to deployment, the tappers shall be checked for free movement and proper position, as outlined on page 2-14.

3. When returning buoys from station, the tender or servicing unit shall remove the following items from the buoy:

- ALL marine growth
- all mooring equipment (bridle, swivel, shackles, etc.).

Wave-Activated Sound Signals

Bells (1000 lb, 225 lb, 85 lb).

Bells do not require any special preparation. They shall be mounted on the appropriate bell stand or tower with isolation pads.

Gongs (36-in. and 20-in. diameter).

Gongs do not require any special preparation. They must be mounted in the proper order (see Data Sheets 2-D(46) and (47)). They are mounted on a gong stand that bolts to the bell and gong support on the buoy body.

Whistles. Installation of a whistle requires a whistle valve, which shall be checked to insure that the four internal rubber or covered cork balls are seated properly. These balls shall be replaced each time the buoy is overhauled. After installation on the buoy, the space between the whistle bell and the whistle body should be adjusted to 15/16 in. $\pm$ 1/16 in.

Wave-Activated Sound Signals (cont'd)

Tappers

● 1952 Type

1. The taper ball shall have its centerline located $1\frac{1}{4}$ in. above the bell's lower edge or $\frac{1}{4}$ in. above the gong's lower edge.

2. The $\frac{1}{2}$ -in. thick neoprene conveyor belting material in the hinge of this type of taper shall be replaced during each buoy overhaul. Material is cut to the size listed in Table 2-12. The hinge shall never be painted.

Table 2-12
1952-Type Tapper Hinge

<u>Buoy</u>	<u>Hinge Size (In.)</u>
6X20	6 X $9\frac{1}{2}$
8X26	8 X $9\frac{1}{2}$
9X32	8 X 11
9X20	8 X $9\frac{1}{2}$

3. A taper shall be replaced under any of the following conditions:

- the ball has broken off or the taper bar has broken
- the taper ball has more than a $1\frac{1}{4}$ -in. deep notch worn in it
- the bar is cracked.

When the only damage to a taper bar is a bend more than $2\frac{1}{2}$ in. from a straight line measured over a 2-ft distance, the taper may be straightened and reused.

● 1962 Type and Adjustable Type

1. A taper shall be replaced under any of the following conditions:

- the taper bar is broken
- the metal hinge bar is worn to a $\frac{3}{4}$ -in. diameter
- the metal hinge ring is worn to a $\frac{1}{16}$ -in. thickness at the lower end.

When the only damage to a taper bar is a bend more than 3 in. from a straight line

measured over a 2-ft distance, the taper may be straightened and reused.

2. The taper ball shall be turned when it has a notch 1 in. deep (or deeper) worn in one side. When it can no longer be turned to an unworn area, the ball shall be replaced.

3. The taper ball shall be adjusted to have its centerline striking the bell or gong at the lower edge to $\frac{1}{4}$ in. above it.

● Standard Adjustable Type. The standard adjustable taper replaces the 19 types of 1952- and 1962-type tappers with two standard tappers, two special-order tappers, and an adapter plate. The design is shown in CG Drawing No. 120382 (see Data Sheet 2-D(48)). An adapter plate allows the same metal hinge to be used on both 1952-type rubber hinge and 1962-type metal hinge taper mounts.

1. Installation of the new type of taper does not require structural modification to the buoy except in the case of the 1952-type, 6X20 LBR. In this case, an adapter plate is not used. The top portion of the rubber hinge taper is unbolted from the buoy tower. This leaves four bolt holes for $\frac{5}{8}$ -in. bolts. The two outside bolt holes must be enlarged for $\frac{3}{4}$ -in. bolts. Install the taper with just these two bolts. Two additional holes must be drilled to receive $\frac{3}{4}$ -in. bolts. Both the 1952- and 1962-type, 6X20 LBR tappers use only four bolts, while all other mountings require five $\frac{3}{4}$ -in. bolts.

2. On all 1952-type bell and gong buoys, except the 6X20 LBR, the adapter plate must be used. Bolts for mounting this plate to the buoy are not provided because existing bolts shall be used. The taper is bolted to the adapter plate using the five $\frac{3}{4}$ -in. bolts provided.

In all cases, after the taper is mounted, the taper ball should be adjusted to the proper height and the nuts tightened. Excess taper bar must then be removed by cutting it below the lower securing nut.

C. INSPECTION, MAINTENANCE, AND REPAIR ON STATION

Inspection and Maintenance Schedule

Lighted Buoys. Lighted buoys and their equipment shall be inspected annually.

Unlighted Buoys. Unlighted buoys and their equipment shall be inspected annually.

Moorings. The moorings of all buoys shall be inspected every 2 yr.

Inspection and Maintenance Requirements

Lighting Equipment. All lighting equipment, including lamps, flashers, lamp-changers, daylight controls, and lanterns, shall be inspected as outlined in Chapter 6.

Power Units. Power units shall be inspected as outlined in Chapter 9.

Wiring. All wiring shall be visually checked for cracking and deterioration. Any wire that is not in "like new" condition shall be replaced. A megohmmeter test can be performed to check for grounds and shorts in the cable. Wire terminal lugs shall be checked and replaced if necessary. Wiring clips shall be checked to insure that the wire is secure. Stuffing tubes shall be inspected and replaced if broken, damaged, or cracked.

Vent Valves. The vent valves on lighted buoys shall be inspected to insure that their balls are free to move; if not, the vent valve shall be replaced. Whenever battery failure occurs, the vent lines and crossover pipe shall be checked to insure that they are not plugged.

Retroreflective Material. Any retroreflective material that is peeling or excessively faded shall be replaced as outlined in Chapter 3.

Sound Equipment

● Tappers. The tapper hinges shall be checked for wear and to insure that they move freely. Tapper balls that are worn shall be turned or replaced.

● Bells and Gongs. The bells or gongs shall be checked for loose mounting bolts.

● Whistles. On whistle buoys, the ball valves shall be checked for free operation and any dirt or salt shall be cleaned away from the whistle air gap. The gap shall be adjusted to 15/16 in. $\pm$ 1/16 in. (page 2-13).

Tower Junction. The junction of the tower to the buoy shall be examined for cracks or broken feet. Repairs shall be made by welding the tower with No. 7018, 6013, or 6011 steel electrodes.

Buoy Exterior

● Above the Waterline. The exterior vinyl alkyd enamel used as a topcoat on the superstructure shall be touched up. See the *Coatings and Color Manual* (CG-263) for additional details on painting.

● Below the Waterline. The underwater portion of the hull, when possible, shall be scraped to remove marine growth. Any bare areas of the hull shall be repainted with antifouling paint. See CG-263 for details on painting.

Buoy Pockets. Swingbolt pockets shall have any bent or broken swingbolts replaced. The gaskets on these pockets can be reused. V-bands shall be inspected for cracks in the T-bolts or spot welds. Insure that the proper V-band size is installed. Cork V-band gaskets should not be reused. After sealing the pocket, an air test shall be performed, as outlined on page 2-10.

Mooring Attachments. Swing arms on flat-bottom buoys; mooring pins on first-, second-, and third-class buoys; and mooring eyes on 6-, 8-, and 9-ft diameter lighted buoys shall be inspected for excessive wear. Mooring pins shall be checked to see if they require replacement.

Chain. Chains shall be inspected and replaced if determined that they will not last until the next mooring inspection. Any chain with deformed links has

Inspection and Maintenance Requirements (cont'd)

probably been stretched and weakened. The links usually pull into a "peanut" shape when overstrained. Links can also be bent or twisted. Chain links showing any of these conditions shall not be reused. The chafe section of the chain, as well as the part of the bridle near the buoy body, is likely to show the greatest wear. Inspection for wear and corrosion is done by measuring the most worn chain link (with a caliper) at its smallest diameter.

A chain shall be replaced prior to wearing to 50 percent of its original strength. Table 2-13 is a guideline for determining chain strength from diameter measurements.

When inspecting chain, it is important to know its condition at the time of the last mooring inspection. One method of accomplishing this is to keep records of the chain sizes in the remarks section of SANDS forms. By comparing the size at the last mooring inspection with the size measured during the current inspection, a rate of wear per year can be estimated. This rate is the key to how long a particular mooring will last. A larger chafe chain can be substituted if the rate of wear prevents leaving the mooring down for at least 2 yr.

Shackles. Split-key shackles are used to connect the bridle to the buoy, the swivel to the bridle and mooring chain, and the mooring chain to the sinker. When a split-key shackle is installed in the swivel, make sure that the shackle pin head lies toward the buoy counterweight. The use of stainless steel keys will enhance the corrosion resistance of the key. Riveted-pin shackles are used in the mooring chain. Using shackles in the chafe section of the chain shall be avoided. If shackles must be used in the chafe section, they shall be of the riveted-pin type. If riveted-pin shackles become excessively worn, they must be cut and removed from the mooring.

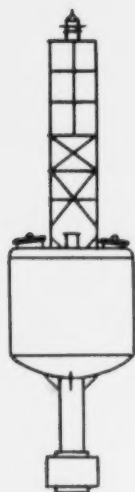
Sinker. If excessive wear is exhibited in the chafe chain, the bail of the sinker must also be inspected for wear. A new sinker shall be installed if it is worn beyond the diameter shown below:

designed sinker bar size	replace when worn to
2 in.	1 in.
1½ in.	¾ in.

Table 2-13
Determination of Chain Strength
from Diameter Measurements

<u>Original Size</u>		<u>Worn Size</u>	
100% Strength (In.)	75% Strength (In.)	50% Strength (In.)	
1 3/4	1 1/2	1 1/4	
1 5/8	1 3/8	1 1/8	
1 1/2	1 1/4	1 1/16	
1 1/4	1 1/16	7/8	
1 1/8	31/32	25/32	
1	7/8	23/32	
7/8	3/4	5/8	
3/4	5/8	1/2	

9X32 LR



Function. The 9X32 LR buoy is designed and constructed for the most exposed locations. This buoy configuration is used when a sound signal is not required.

Buoy weight	17,443 lb
Buoy draft (no mooring)	11 ft-9 in.
Focal height of light (no mooring)	20 ft-2 in.
Freeboard (no mooring)	4 ft-5 in.
Minimum freeboard	1 ft-4 in.
Pounds per inch of immersion	340

Power units (maximum number and size)	2-B30
Bridle size (chain diameter and length)	1½ in. X 18 ft
Mooring chain size	1½ in.
Sinker size	12,750 lb

Nominal visual range of daymark	3.8 nmi
Radar range	4.5 nmi
Maximum current	5 kn
Visual range of light	(see Chapter 6)

Minimum mooring depth	30 ft
Maximum mooring depth (B10)	345 ft
(B30)	325 ft

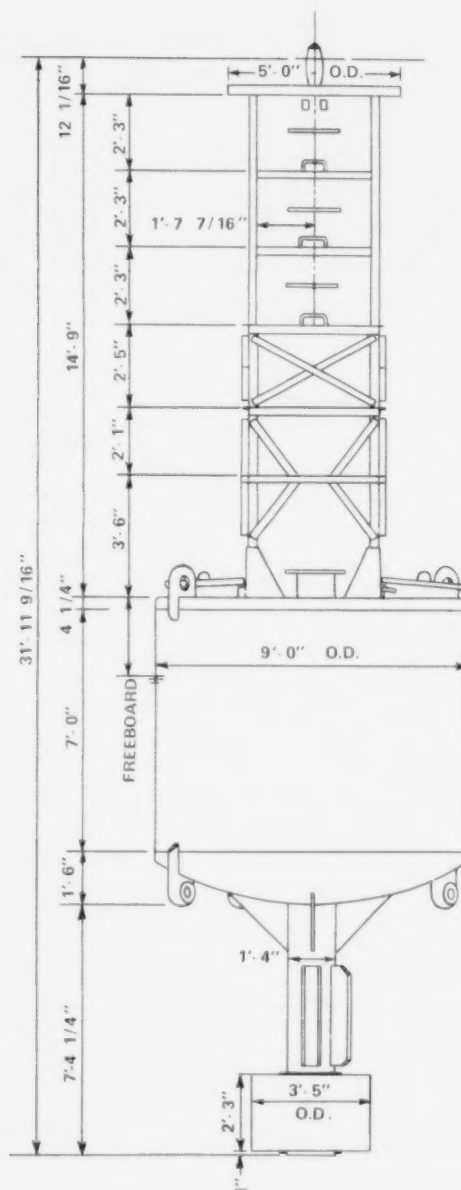


Figure 2-1. Dimensions of the 9X32 LR.

Data Sheet 2-D(1). 9X32 LR buoy.

Additional Data. Buoys with operational characteristics similar to the 1962-type 9X32 LR are shown in Figure 2-2. Both the 1942-type and the 1928-type 9X32 L buoys can have a radar reflector added, giving them the appearance of a 1952-type

buoy, and will have a 1952-type stock number assigned. Although not illustrated, the 1928-type 9X34 LR (NSN 2050-00-G05-7099) has operational characteristics similar to the 1962-type 9X32 LR buoy.

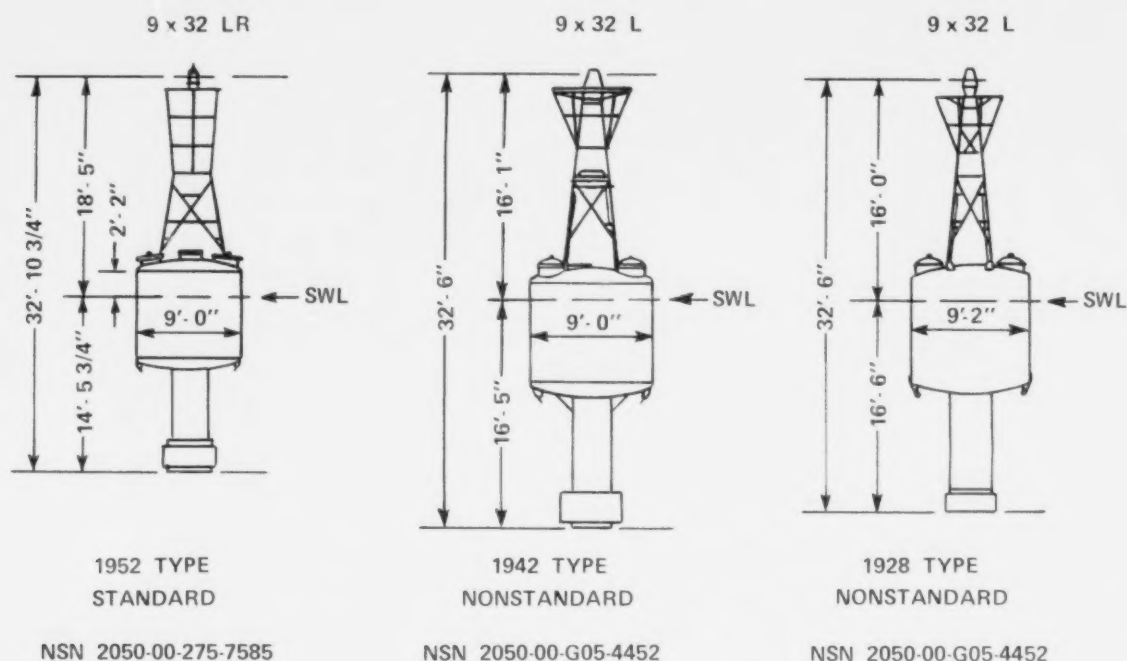
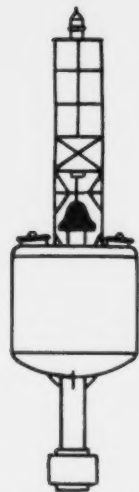


Figure 2-2. Standard and nonstandard substitutes.

9X32 LBR



1962 TYPE
STANDARD

Function. The 9X32 LBR buoy is designed and constructed for the most exposed locations. This buoy configuration is used with a 1000-lb bell, wave-actuated sound signal. The basic buoy is the same as the 9X32 LR.

Physical Characteristics

Buoy weight	19,091 lb
Buoy draft (no mooring)	12 ft-2 in.
Focal height of light (no mooring)	19 ft-9 in.
Freeboard (no mooring)	4 ft-0 in.
Minimum freeboard	1 ft-4 in.
Pounds per inch of immersion	340

Related Equipment

Power units (maximum number and size)	2-B30
Sound equipment	1000-lb bell
Bridle size (chain diameter and length)	1½ in.X18 ft
Mooring chain size	1½ in.
Sinker size	12,750 lb

Operational Characteristics

Nominal visual range of daymark	3.8 nmi
Radar range	4.5 nmi

Operational Characteristics (cont'd)

Maximum current	5 kn
Visual range of light	(see Chapter 6)
Minimum mooring depth	30 ft
Maximum mooring depth (B10A)	300 ft
(B30A)	275 ft

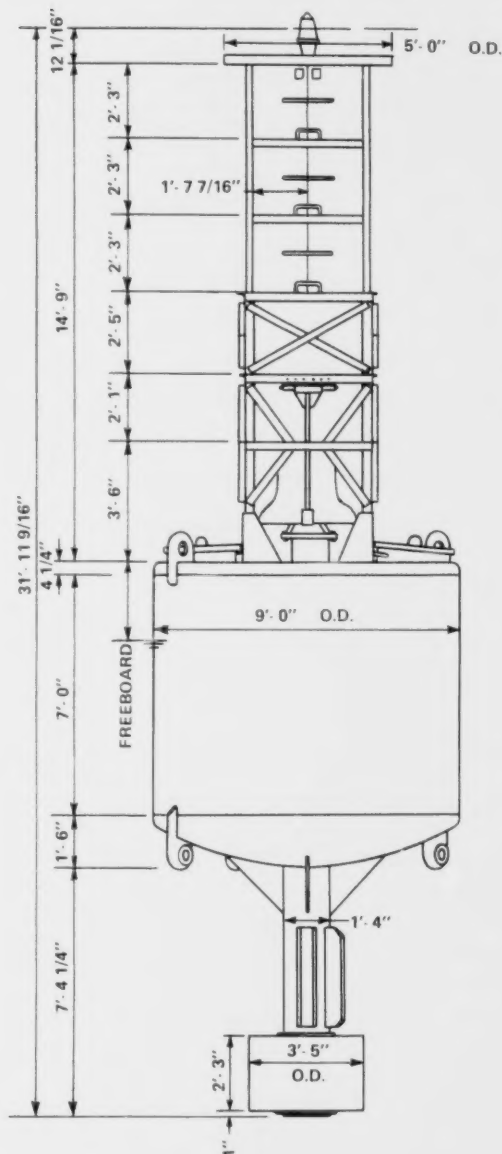


Figure 2-3. Dimensions of the 9X32 LBR.

Data Sheet 2-D(2). 9X32 LBR buoy.

Additional Data. Buoys with operational characteristics similar to the 1962-type 9X32 LBR are shown in Figure 2-4. Both the 1942-type and the 1928-type 9X32 LB

buoys can have a radar reflector added, giving them the appearance of a 1952-type buoy, and will have a 1952-type stock number assigned.

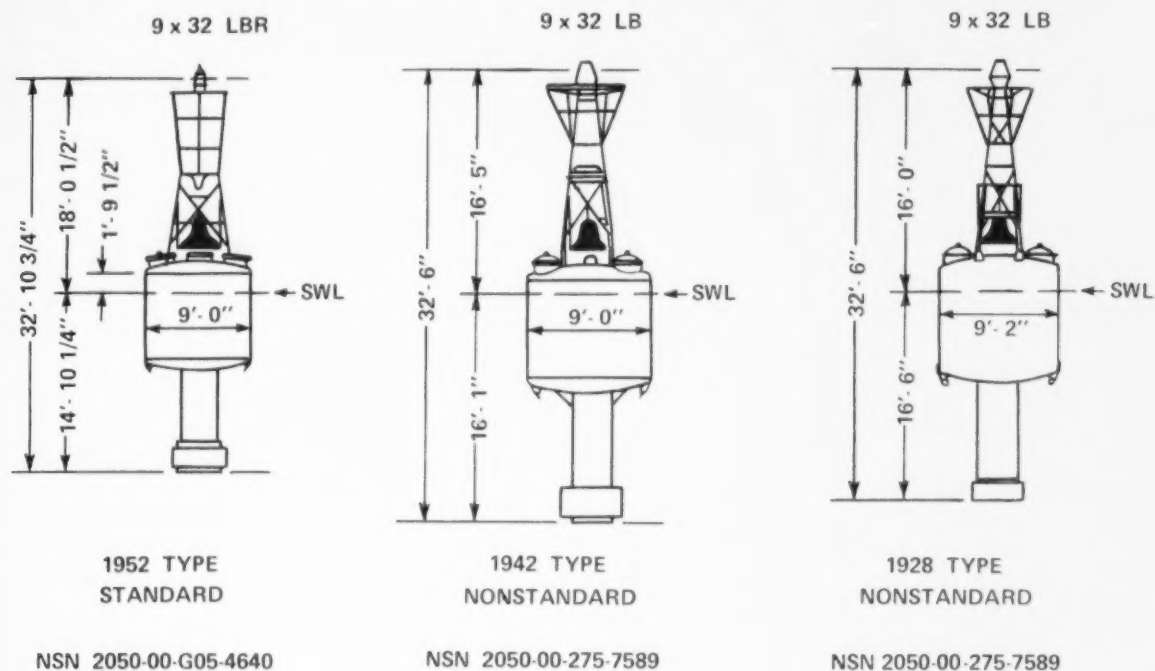


Figure 2-4. Standard and nonstandard substitutes.

9X32 LGR



1962 TYPE
STANDARD

Function. The 9X32 LGR buoy is designed and constructed for the most exposed locations. This buoy configuration is used with a 36-in. diameter, four-gong, wave-actuated sound signal. The basic buoy is the same as the 9X32 LR.

Physical Characteristics

Buoy weight	19,391 lb
Buoy draft (no mooring)	12 ft-3 in.
Focal height of light (no mooring)	19 ft-8 in.
Freeboard (no mooring)	3 ft-11 in.
Minimum freeboard	1 ft-4 in.
Pounds per inch of immersion	340

Related Equipment

Power units (maximum number and size)	2-B30
Sound equipment	4 36-in. gongs
Bridle size (chain diameter and length)	1½ in. X 18 ft
Mooring chain size	1½ in.
Sinker size	12,750 lb

Operational Characteristics

Nominal visual range of daymark	3.8 nmi
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Operational Characteristics (cont'd)

Radar range	4.5 nmi
Maximum current	5 kn
Visual range of light (see Chapter 6)	
Minimum mooring depth	30 ft
Maximum mooring depth (B10A)	285 ft
(B30A)	265 ft

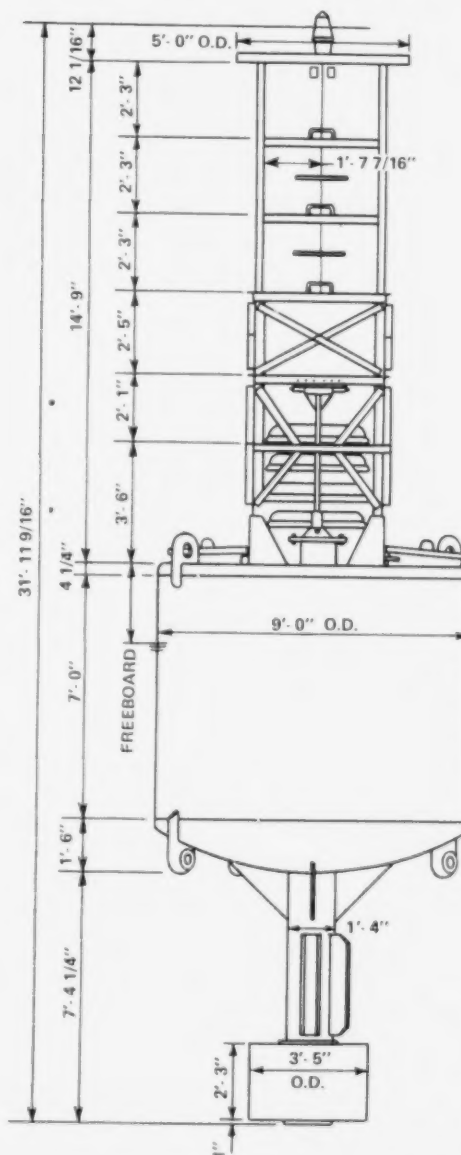
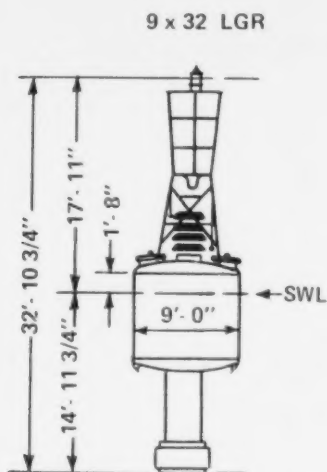


Figure 2-5. Dimensions of the 9X32 LGR.

Data Sheet 2-D(3). 9X32 LGR buoy.

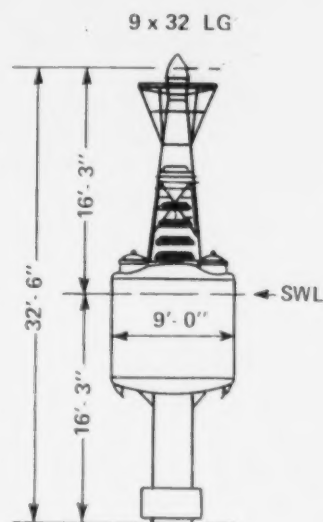
Additional Data. Buoys with operational characteristics similar to the 1962-type 9X32 LGR are shown in Figure 2-6. The 1942-type buoy can have a radar reflector

added, giving it the appearance of a 1952-type buoy, and will have a 1952-type stock number assigned.



1952 TYPE
STANDARD

NSN 2050-00-G05-4641

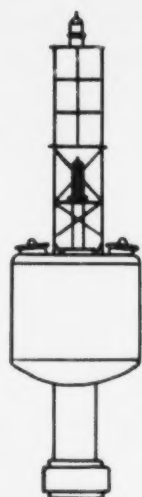


1942 TYPE
NONSTANDARD

NSN 2050-00-275-7591

Figure 2-6. Standard and nonstandard substitutes.

9X32 LWR



**1962 TYPE
STANDARD**

Function. The 9X32 LWR buoy is designed and constructed for the most exposed locations. This buoy configuration is used with a four-ball whistle and whistle valve for the wave-actuated sound signal. The buoy body differs from the 9X32 LR in that it has an open tube running through it to activate the whistle.

Physical Characteristics

Buoy weight	18,616 lb
Buoy draft (no mooring)	12 ft-11 in.
Focal height of light (no mooring)	19 ft-0 in.
Freeboard (no mooring)	3 ft-3 in.
Minimum freeboard	1 ft-4 in.
Pounds per inch of immersion	300

Related Equipment

Power units (maximum number and size)	2-B30
Sound equipment	4-ball whistle
Bridle size (chain diameter and length)	1½ in. X 18 ft
Mooring chain size	1½ in.
Sinker size	12,750 lb

Operational Characteristics

Nominal visual range of daymark	3.8 nmi
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Operational Characteristics (cont'd)

Radar range	4.5 nmi
Maximum current	5 kn
Visual range of light	(see Chapter 6)
Minimum mooring depth	30 ft
Maximum mooring depth (B10A)	180 ft
(B30A)	155 ft

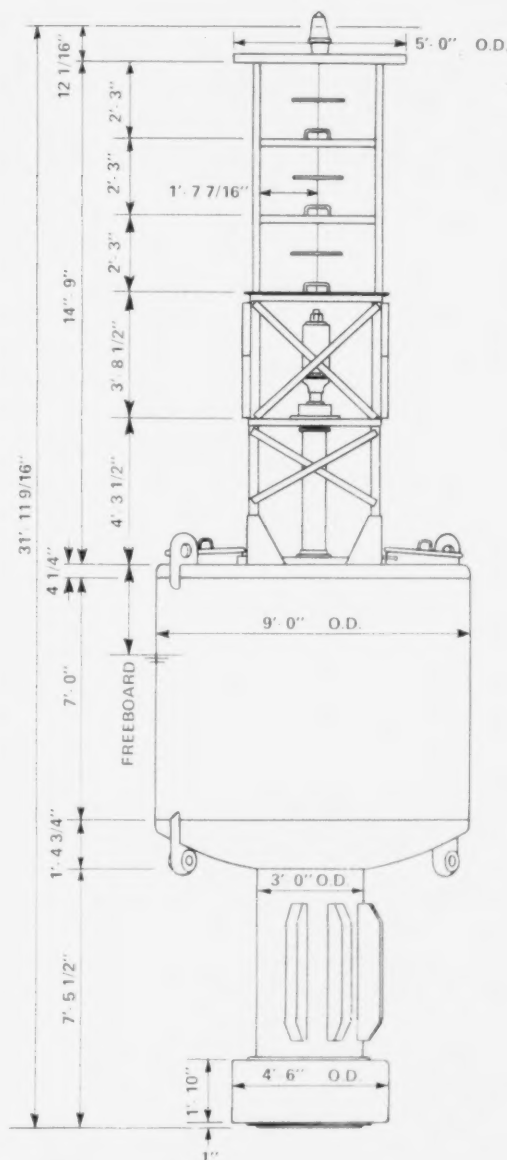


Figure 2-7. Dimensions of the 9X32 LWR.

Data Sheet 2-D(4). 9X32 LWR buoy.

Additional Data. Buoys with operational characteristics similar to the 1962-type 9X32 LWR are shown in Figure 2-8. Both the 1942- and 1928-type 9X38 LW, 9X39 LW, and 10X39 LW buoys can have a radar re-

flector added, giving them the appearance, at least in the superstructure, of a 1952-type buoy, and will have a 1952-type stock number assigned.

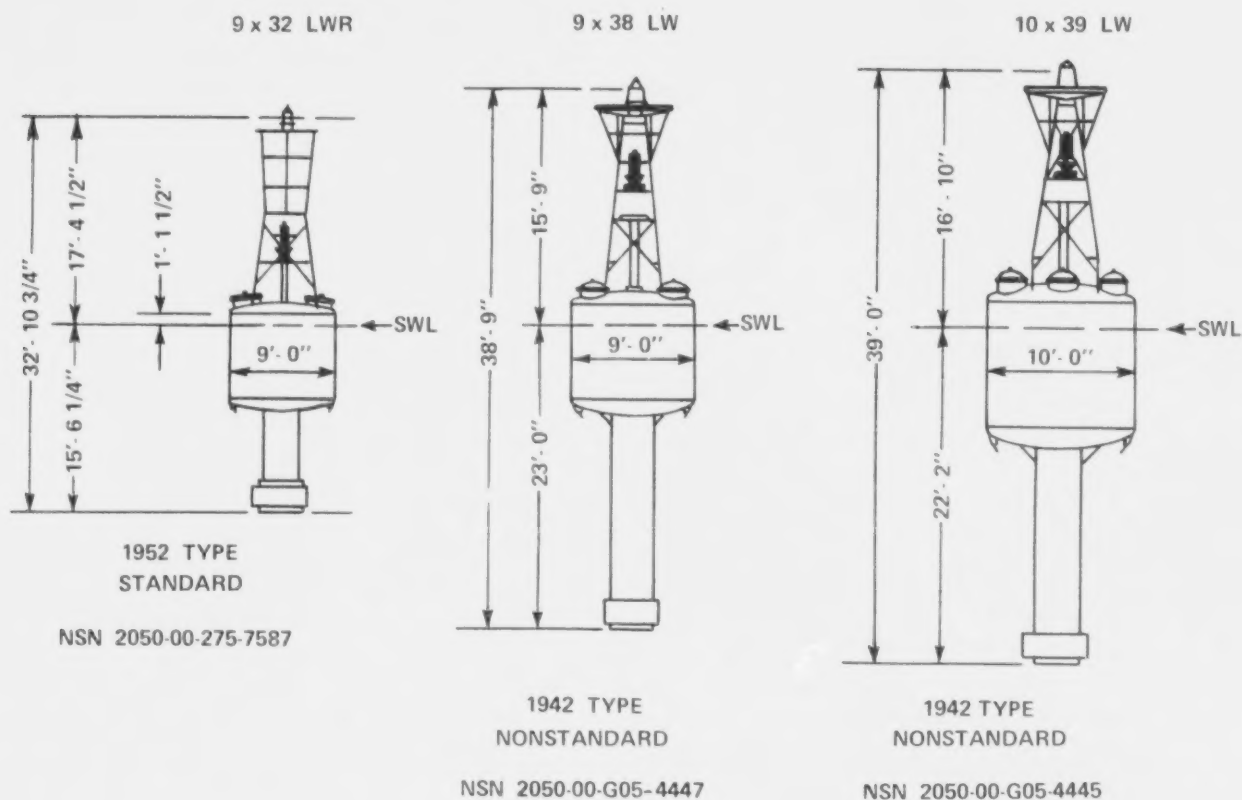


Figure 2-8. Standard and nonstandard substitutes.

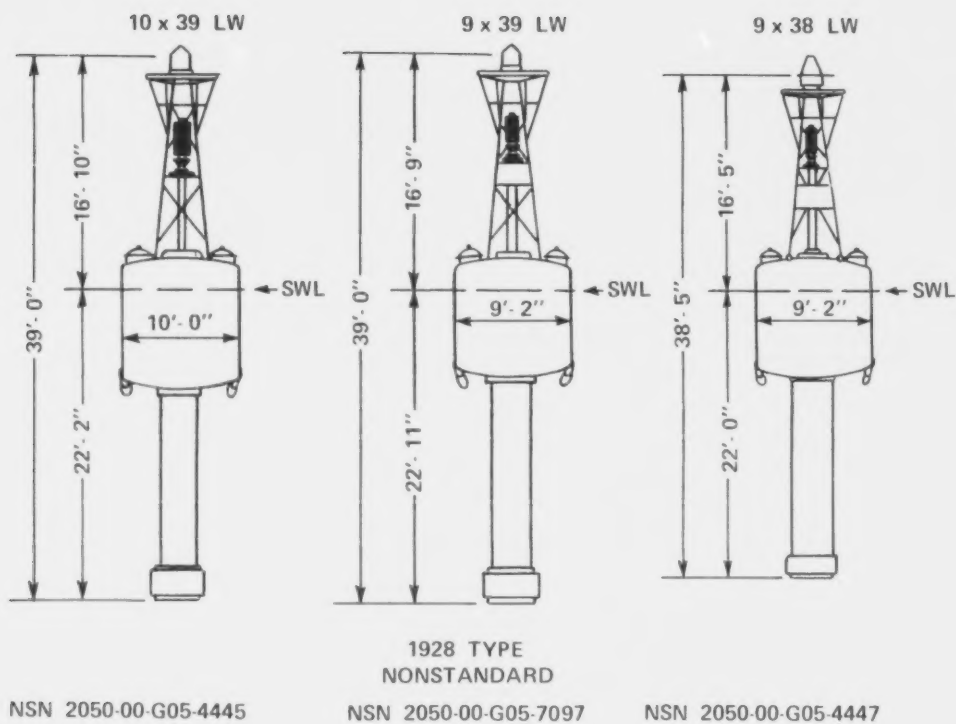
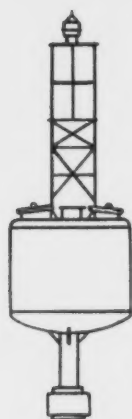


Figure 2-8. (cont'd).



**1962 TYPE
STANDARD**

Function. The 8X26 LR buoy is designed and constructed for exposed or semiexposed locations. This buoy configuration is used when a sound signal is not required.

Physical Characteristics

Buoy weight	11,382 lb
Buoy draft (no mooring)	10 ft-1 in.
Focal height of light (no mooring)	15 ft-10 in.
Freeboard (no mooring)	3 ft-3 in.
Minimum freeboard	1 ft-3 in.
Pounds per inch of immersion	270

Related Equipment

Power units (maximum number and size)	2-B30
Bridle size (chain diameter and length)	1½ in. X 15 ft
Mooring chain size	1½ in.
Sinker size	8,500 lb

Operational Characteristics

Nominal visual range of daymark	3.2 nmi
Radar range	3.7 nmi
Maximum current	4 kn
Visual range of light	(see Chapter 6)

Operational Characteristics (cont'd)

Minimum mooring depth	25 ft
Maximum mooring depth (B10)	240 ft
(B30)	210 ft

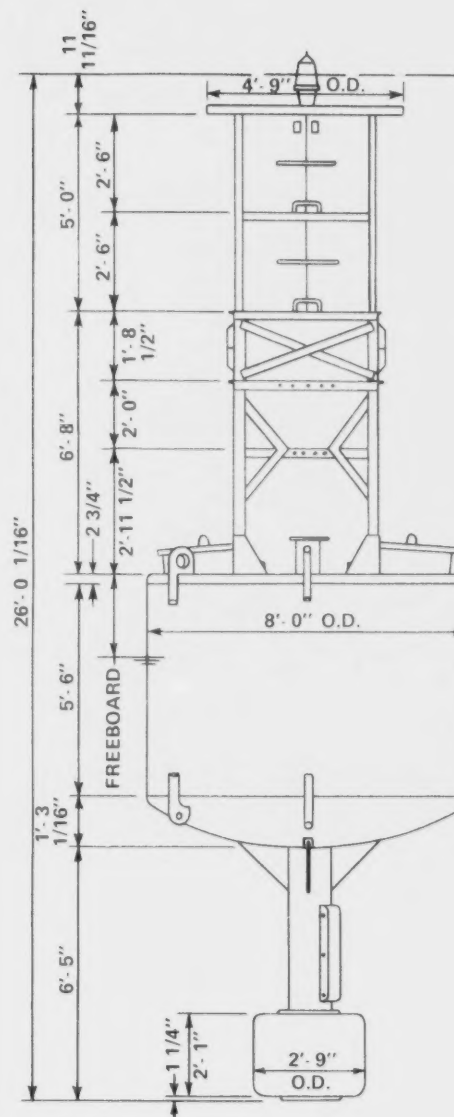


Figure 2-9. Dimensions of the 8X26 LR.

Data Sheet 2-D(5). 8X26 LR buoy.

Additional Data. Buoys with operational characteristics similar to the 1962-type 8X26 LR (the only buoy of this type presently manufactured) are shown in Figure 2-10. Both the 1942-type 8X26 L and the

1928-type 8X23 L and 8X20 L buoys can have a radar reflector added, giving them the appearance, at least in the superstructure, of the 1952-type buoy.

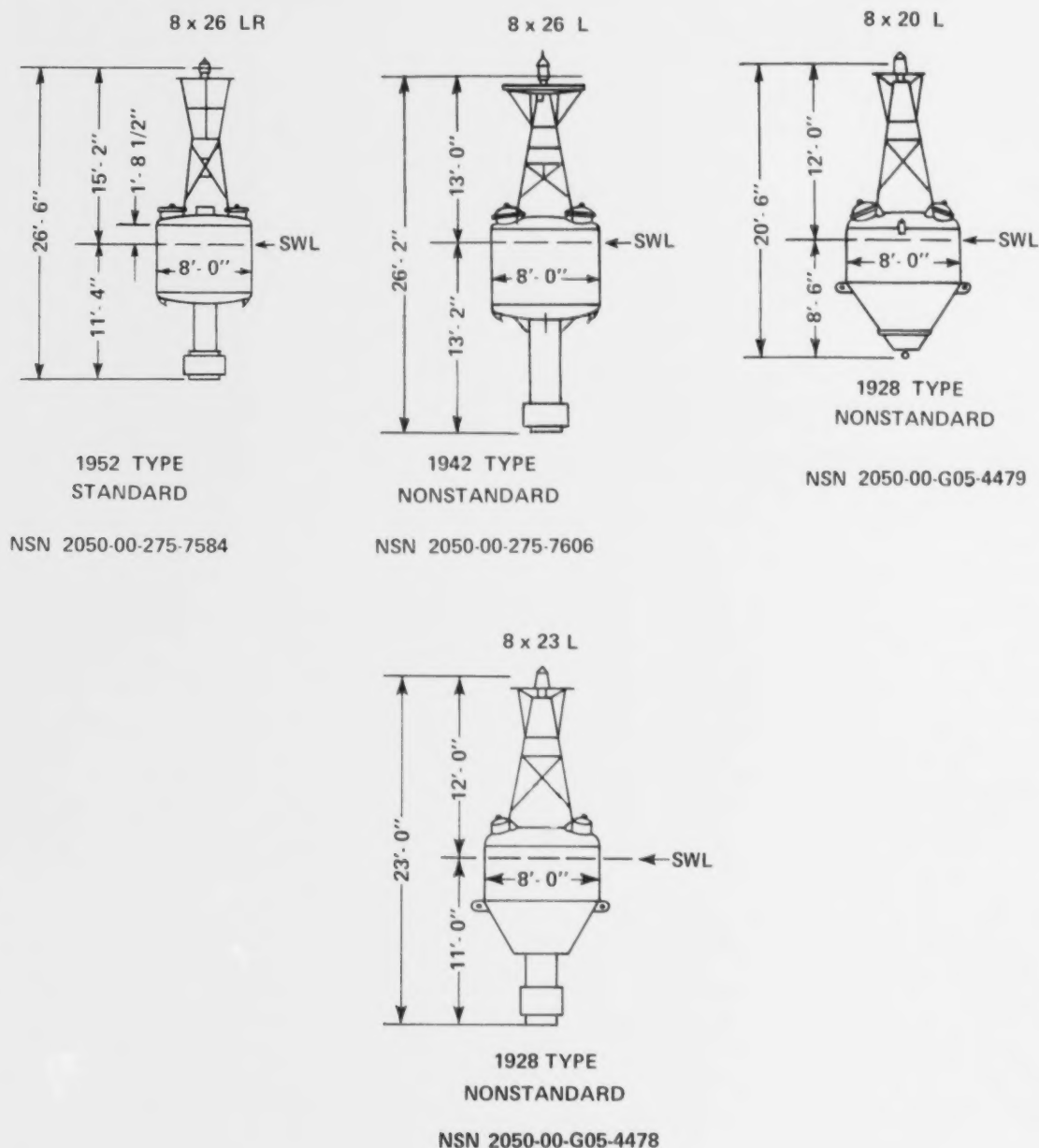
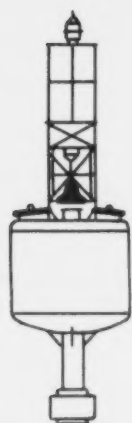


Figure 2-10. Standard and nonstandard substitutes.

Data Sheet 2-D(5). (cont'd).

8X26 LBR



1962 TYPE
STANDARD

Function. The 8X26 LBR buoy is designed and constructed for exposed or semiexposed locations. This buoy configuration is used with a 225-lb bell, wave-actuated sound signal. The basic buoy is the same as the 8X26 LR.

Physical Characteristics

Buoy weight	11,917 lb
Buoy draft (no mooring)	10 ft-3 in.
Focal height of light (no mooring)	15 ft-8 in.
Freeboard (no mooring)	3 ft-1 in.
Minimum freeboard	1 ft-3 in.
Pounds per inch of immersion	270

Related Equipment

Power units (maximum number and size)	2-B30
Sound equipment	225-lb bell
Bridle size (chain diameter and length)	1½ in. X 15 ft
Mooring chain size	1½ in.
Sinker size	8,500 lb

Operational Characteristics

Nominal visual range of daymark	3.2 nmi
Radar range	3.7 nmi

Operational Characteristics (cont'd)

Maximum current	4 kn
Visual range of light	(see Chapter 6)
Minimum mooring depth	25 ft
Maximum mooring depth (B10)	220 ft
(B30)	190 ft

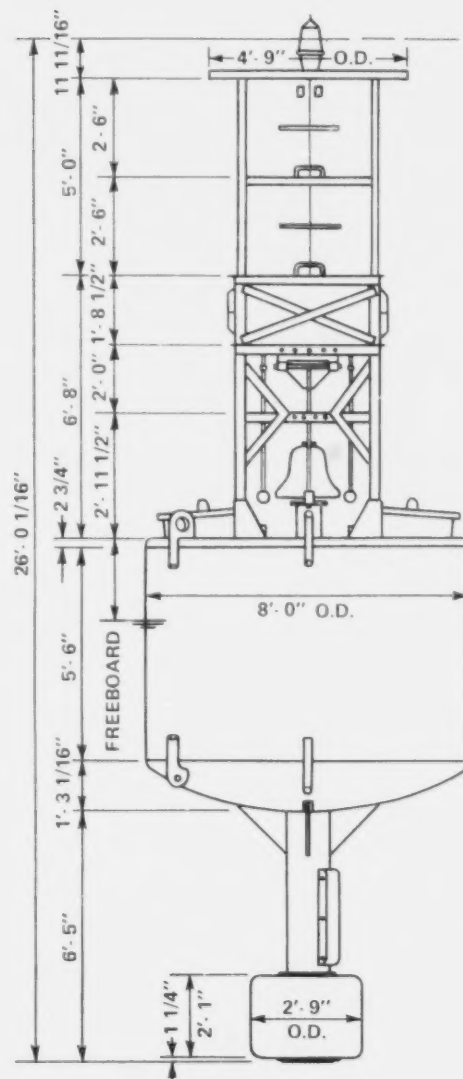


Figure 2-11. Dimensions of the 8X26 LBR.

Data Sheet 2-D(6). 8X26 LBR buoy.

Additional Data. Buoys with operational characteristics similar to the 1962-type 8X26 LBR (the only buoy of this type presently manufactured) are shown in Figure 2-12. Both the 1942-type 8X26 LB and the

1928-type 8X20 LB buoys can have a radar reflector added, giving them the appearance, at least in the superstructure, of the 1952-type buoy, and will have a 1952-type stock number assigned.

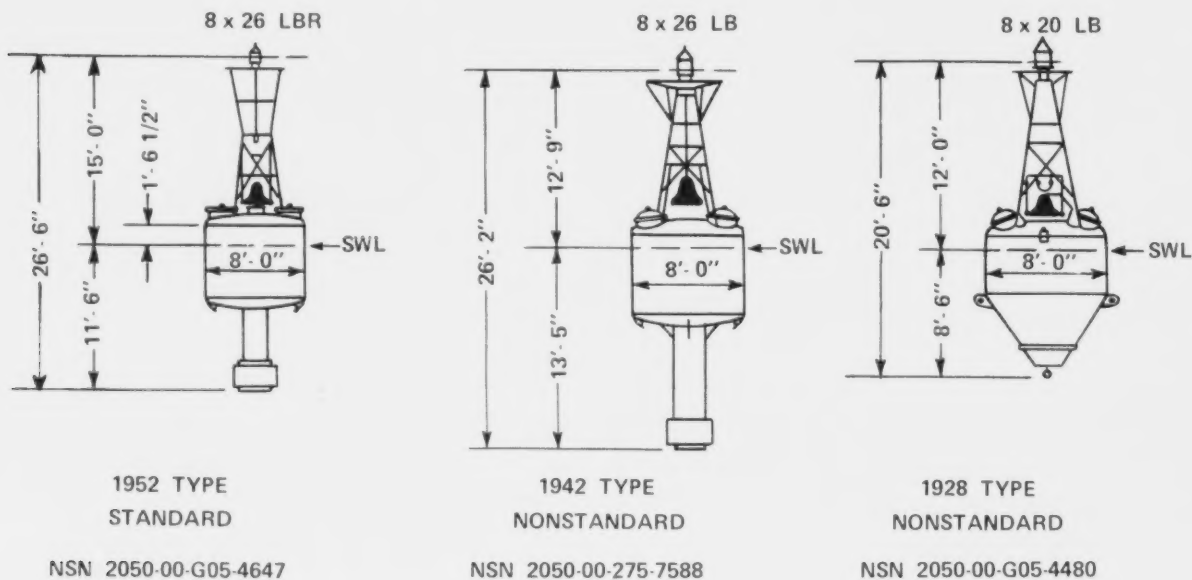


Figure 2-12. Standard and nonstandard substitutes

8X26 LGR



1962 TYPE
STANDARD

Function. The 8X26 LGR buoy is designed and constructed for exposed or semiexposed locations. This buoy configuration is used with a 20-in. diameter, three-gong, wave-actuated sound signal. The basic buoy is the same as the 8X26 LR.

Physical Characteristics

Buoy weight	11,853 lb
Buoy draft (no mooring)	10 ft-3 in.
Focal height of light (no mooring)	15 ft-8 in.
Freeboard (no mooring)	3 ft-1 in.
Minimum freeboard	1 ft-3 in.
Pounds per inch of immersion	270

Related Equipment

Power units (maximum number and size)	2-B30
Sound equipment	3 20-in. gongs
Bridle size (chain diameter and length)	1 1/4 in. X 15 ft
Mooring chain size	1 1/4 in.
Sinker size	8,500 lb

Operational Characteristics

Nominal visual range of daymark	3.2 nmi
Radar range	3.7 nmi

Operational Characteristics (cont'd)

Maximum current	4 kn
Visual range of light	(see Chapter 6)
Minimum mooring depth	25 ft
Maximum mooring depth (B10)	220 ft
(B30)	190 ft

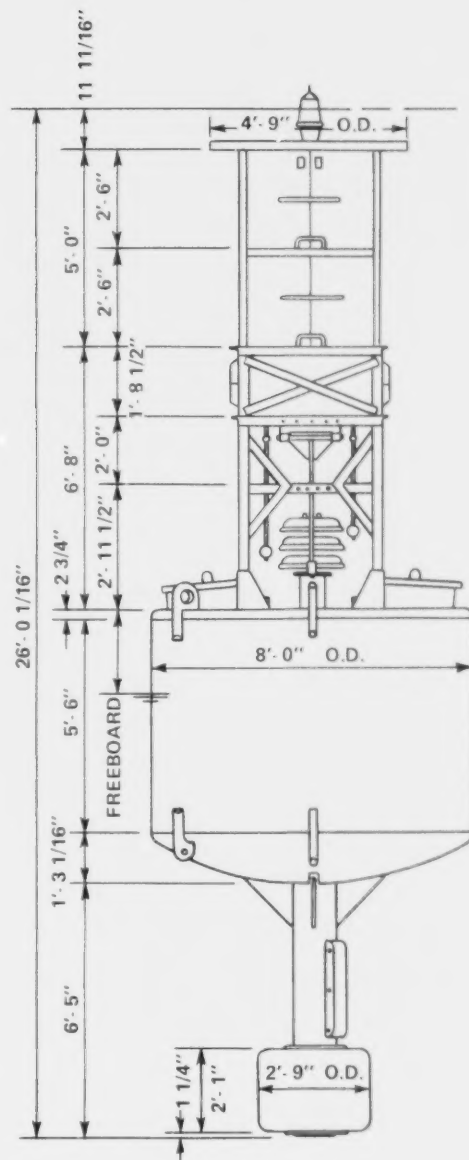


Figure 2-13. Dimensions of the 8X26 LGR.

Data Sheet 2-D(7). 8X26 LGR buoy.

Additional Data. Buoys with operational characteristics similar to the 1962-type 8X26 LGR (the only buoy of this type presently manufactured) are shown in Figure 2-14. Both the 1942-type 8X26 LG and the

1928-type 8X20 LG buoys can have a radar reflector added, giving them the appearance, at least in the superstructure, of the 1952-type buoy, and will have a 1952-type stock number assigned.

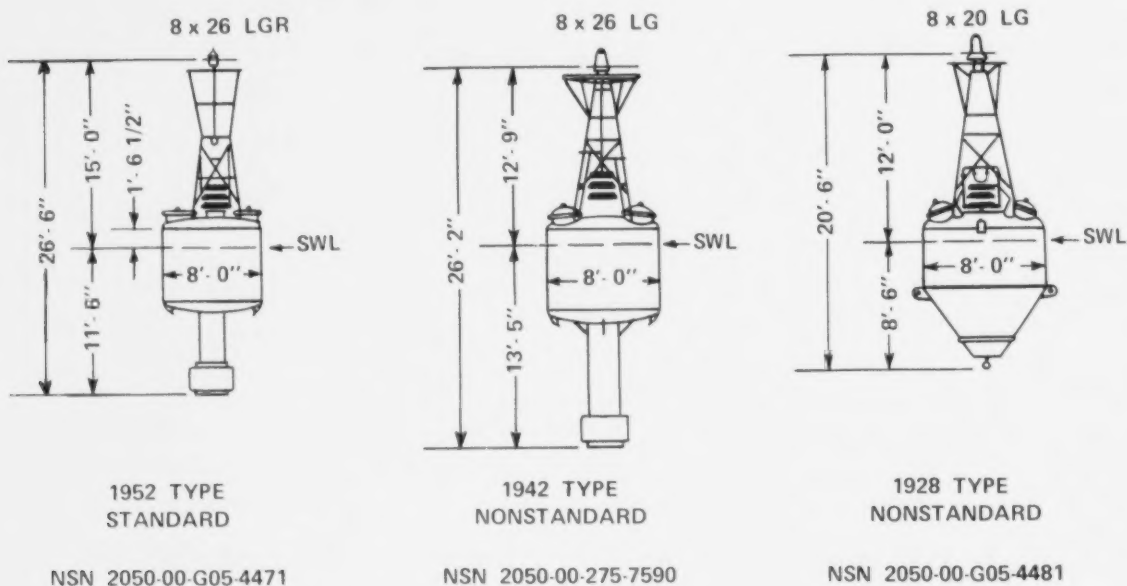
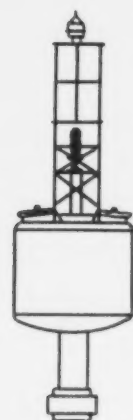


Figure 2-14. Standard and nonstandard substitutes.

8X26 LWR

Operational Characteristics (cont'd)

Radar range	3.7 nmi
Maximum current	4 kn
Visual range of light	(see Chapter 6)
Minimum mooring depth	25 ft
Maximum mooring depth (B10)	90 ft
Maximum mooring depth (B30)	60 ft



1962 TYPE
STANDARD

Function. The 8X26 LWR buoy is designed and constructed for exposed or semiexposed locations. This buoy configuration is used with a four-ball whistle and whistle valve for the wave-actuated sound signal. The buoy body differs from the 8X26 LR in that it has an open tube running through it to activate the whistle.

Physical Characteristics

Buoy weight	12,131 lb
Buoy draft (no mooring)	10 ft-9 in.
Focal height of light (no mooring)	15 ft-2 in.
Freeboard (no mooring)	2 ft-2 in.
Minimum freeboard	1 ft-3 in.
Pounds per inch of immersion	250

Related Equipment

Power units (maximum number and size)	2-B30
Sound equipment	4-ball whistle
Bridle size (chain diameter and length)	1 1/4 in. X 15 ft
Mooring chain size	1 1/4 in.
Sinker size	8,500 lb

Operational Characteristics

Nominal visual range of daymark	3.2 nmi
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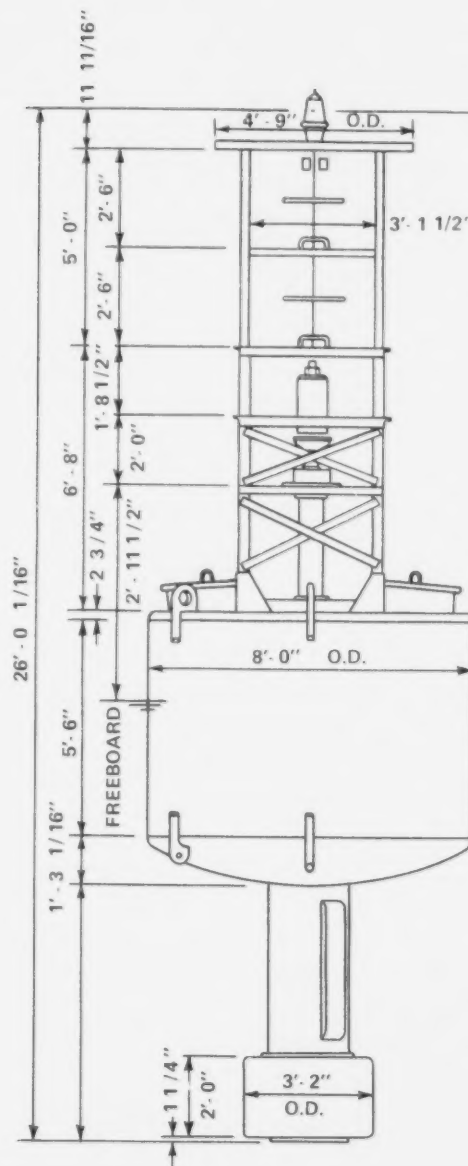


Figure 2-15. Dimensions of the 8X26 LWR.

Data Sheet 2-D(8). 8X26 LWR buoy.

Additional Data. Buoys with operational characteristics similar to the 1962-type 8X26 LWR (the only buoy of this type presently manufactured) are shown in Figure 2-16. Both the 1942-type 8X26 LW and the

1928-type 8X23 LW buoys can have a radar reflector added, giving them the appearance, at least in the superstructure, of the 1952-type buoy, and will have a 1952-type stock number assigned.

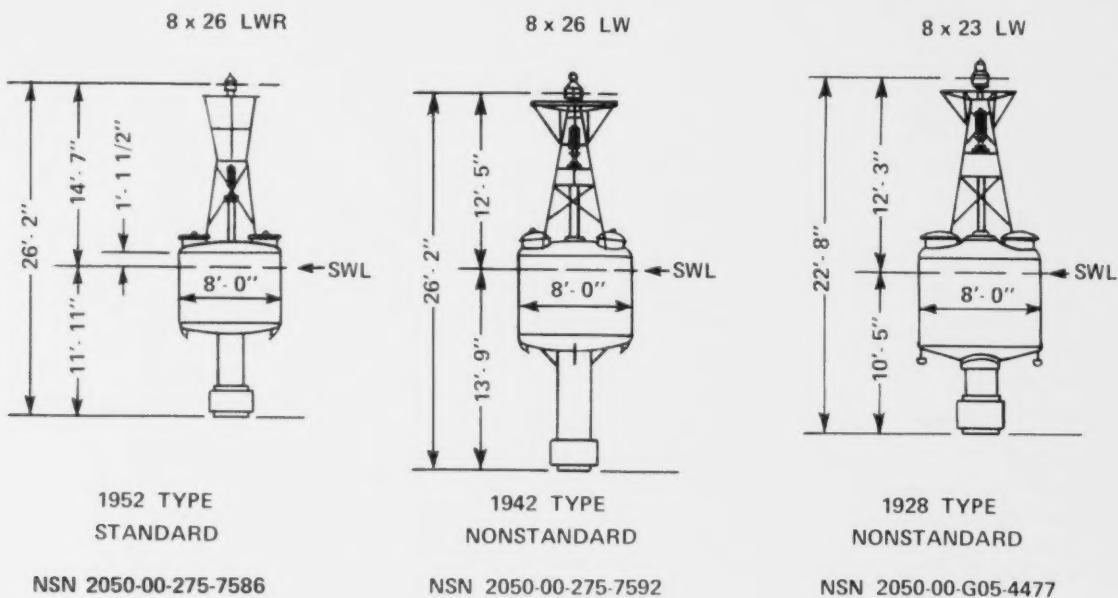
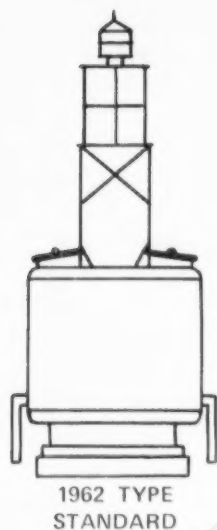


Figure 2-16. Standard and nonstandard substitutes.

7X17 LR

Operational Characteristics (cont'd)

Visual range of light	(see Chapter 6)
Minimum mooring depth	15 ft
Maximum mooring depth (B10)	220 ft
(B30)	185 ft



Function. The 7X17 LR buoy is designed and constructed for semiexposed locations. This buoy configuration cannot have a wave-actuated sound signal installed. The 7X17 LR is very effective in shallow water areas due to its flat bottom.

Physical Characteristics

Buoy weight	7,810 lb
Buoy draft (no mooring)	5 ft-6 in.
Focal height of light (no mooring)	11 ft-8 in.
Freeboard (no mooring)	3 ft-0 in.
Minimum freeboard	12 in.
Pounds per inch of immersion	205

Related Equipment

Power units (maximum number and size)	2-B30
Bridle size (chain diameter and length)	1 1/4 in. X 15 ft
Mooring chain size	1 1/8 in.
Sinker size	6,500 lb

Operational Characteristics

Nominal visual range of daymark	2.3 nmi
Radar range	2.7 nmi
Maximum current	4 kn

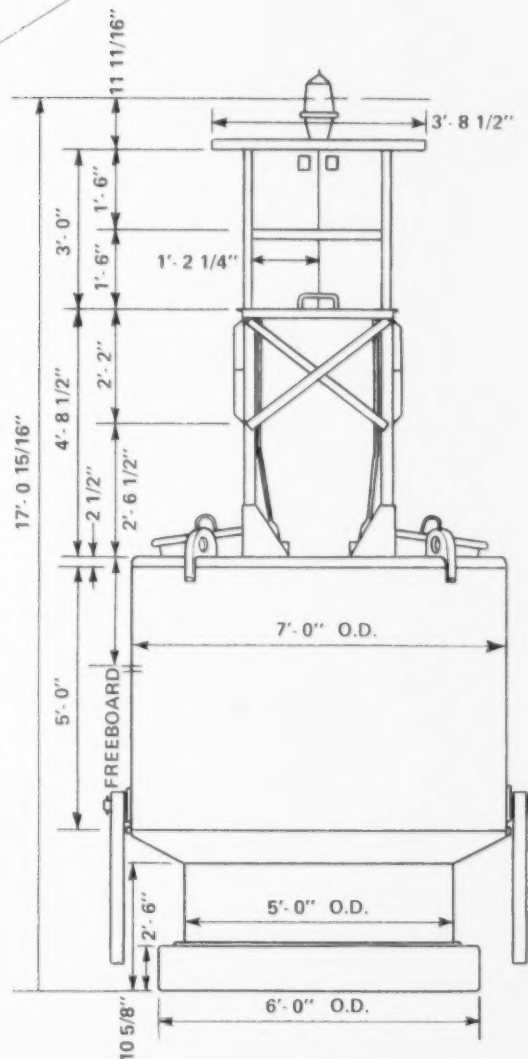


Figure 2-17. Dimensions of the 7X17 LR.

Data Sheet 2-D(9). 7X17 LR buoy.

Additional Data. Buoys with operational characteristics similar to the 1962-type 7X17 LR (the only buoy of this type presently manufactured) are shown in Figure 2-18. Both the 1942-type 7X15 L and the 1928-type 7X18 L buoys can have a radar reflector added, giving them the appear-

ance, at least in the superstructure, of the 1952-type buoy, and will have a 1952-type stock number assigned. Although not illustrated, the 1928-type 7X14 L (NSN 2050-00-G05-4493) also has operational characteristics similar to the 1962-type 7X17 LR buoy.

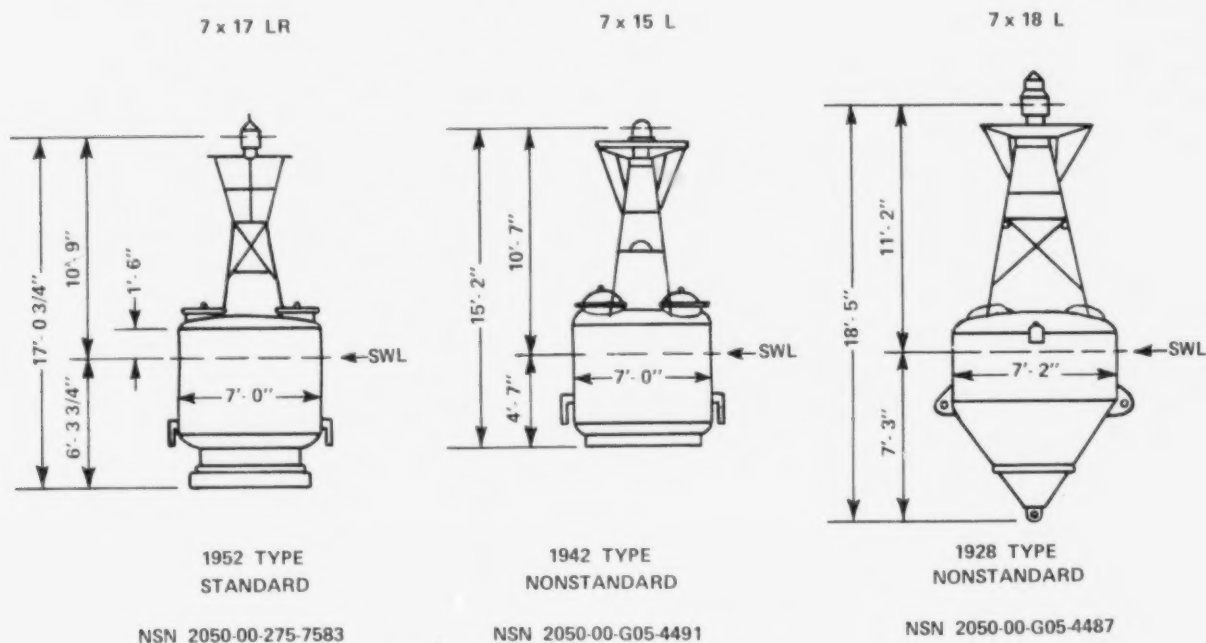
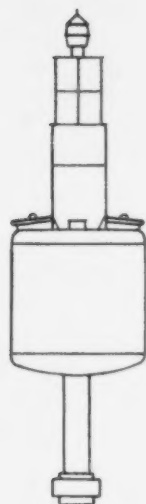


Figure 2-18. Standard and nonstandard substitutes.

6X20 LR

Operational Characteristics (cont'd)

Minimum mooring depth	20 ft
Maximum mooring depth (B10)	185 ft
(B30)	145 ft



1962-TYPE
STANDARD

Function. The 6X20 LR buoy is designed and constructed for semiexposed or protected locations. This buoy configuration is used when a sound signal is not required.

Physical Characteristics

Buoy weight	6,023 lb
Buoy draft (no mooring)	8 ft-8 in.
Focal height of light (no mooring)	10 ft-10 in.
Freeboard (no mooring)	2 ft-5 in.
Minimum freeboard	12 in.
Pounds per inch of immersion	150

Related Equipment

Power units (maximum number and size)	2-B30
Bridle size (chain diameter and length)	1 in.X12 ft
Mooring chain size	1 1/8 in.
Sinker size	5,000 lb

Operational Characteristics

Nominal visual range of daymark	2.1 nmi
Radar range	2.4 nmi
Maximum current	4 kn
Visual range of light	(see Chapter 6)

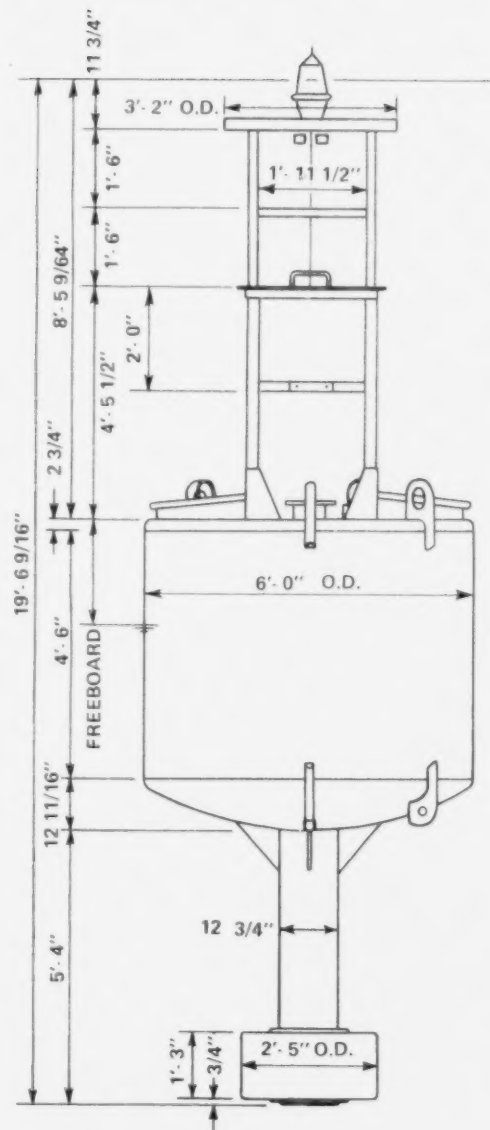


Figure 2-19. Dimensions of the 6X20 LR.

Data Sheet 2-D(10). 6X20 LR buoy.

Additional Data. Buoys with operational characteristics similar to the 1962-type 6X20 LR (the only buoy of this type presently manufactured) are shown in Figure 2-20. The 1942-type 6X20 L buoy can have a radar reflector added, giving it the appearance of the 1952-type buoy, and will

have a 1952-type stock number assigned. Although not illustrated, the 1928-type 6X23 L (NSN 2050-00-G05-4492) and the 1928-type 6X22 L (NSN 2050-00-G05-4495) also have operational characteristics similar to the 1962-type 6X20 LR buoy.

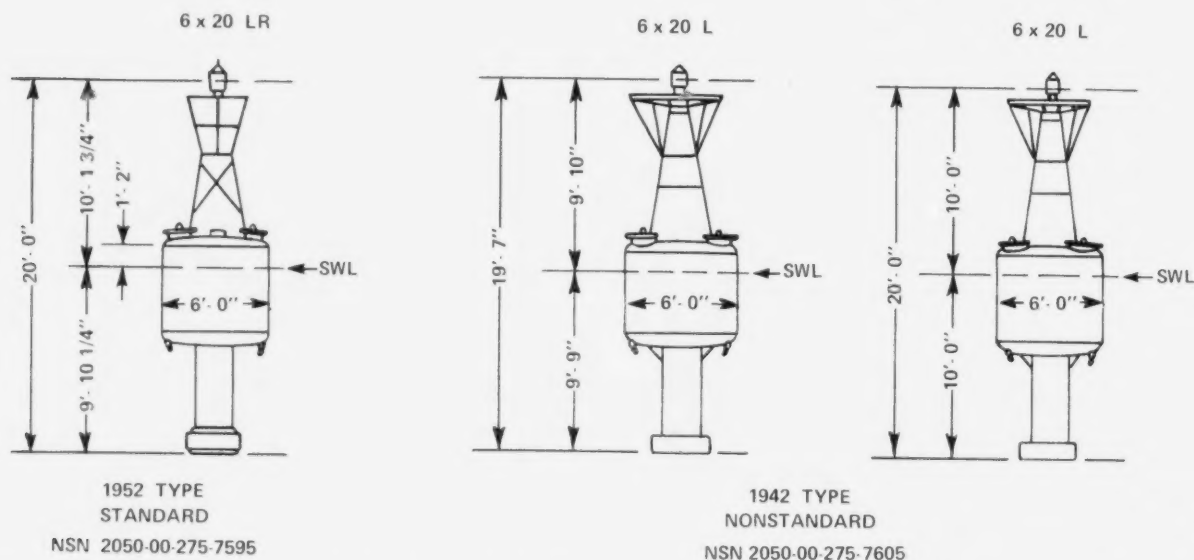
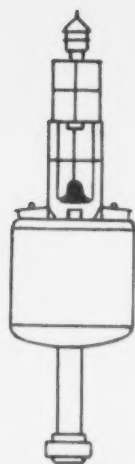


Figure 2-20. Standard and nonstandard substitutes.

6X20 LBR



1962 TYPE
STANDARD

Function. The 6X20 LBR buoy is designed and constructed for semiexposed or protected locations. This buoy configuration is used with an 85-lb bell, wave-actuated sound signal. The basic buoy is the same as the 6X20 LR.

Physical Characteristics

Buoy weight	6,270 lb
Buoy draft (no mooring)	8 ft-10 in.
Focal height of light (no mooring)	10 ft-8 in.
Freeboard (no mooring)	2 ft-3 in.
Minimum freeboard	12 in.
Pounds per inch of immersion	150

Related Equipment

Power units (maximum number and size)	2-B30
Sound equipment	85-lb bell
Bridle size (chain diameter and length)	1 in.X12 ft
Mooring chain size	1 1/8 in.
Sinker size	5,000 lb

Operational Characteristics

Nominal visual range of daymark	2.1 nmi
Radar range	2.4 nmi

Operational Characteristics (cont'd)

Maximum current	4 kn
Visual range of light	(see Chapter 6)
Minimum mooring depth	20 ft
Maximum mooring depth (B10)	175 ft
(B30)	135 ft

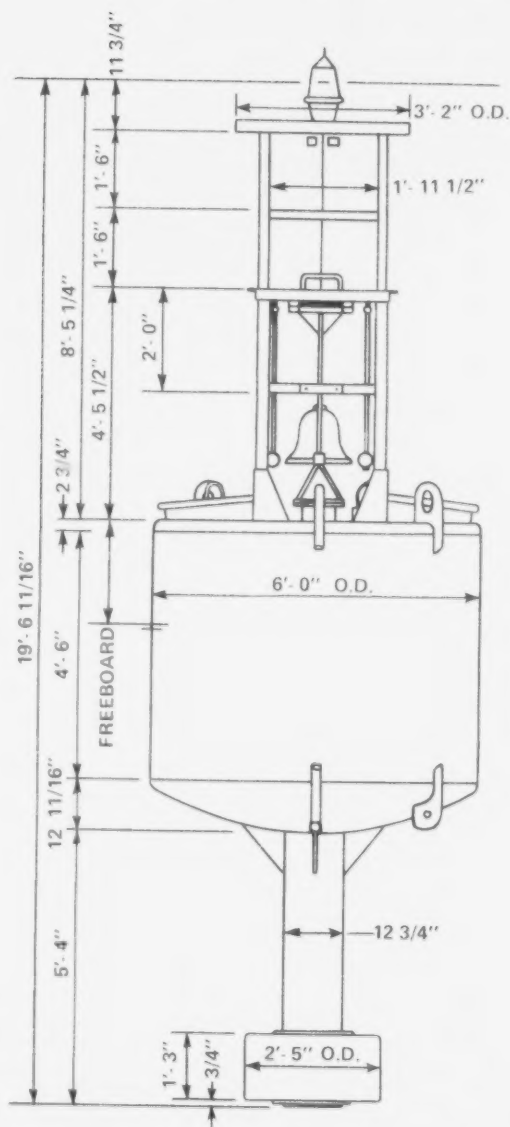


Figure 2-21. Dimensions of the 6X20 LBR.

Data Sheet 2-D(11). 6X20 LBR buoy.

Additional Data. Buoys with operational characteristics similar to the 1962-type 6X20 LBR (the only buoy of this type presently manufactured) are shown in Figure 2-22. The 1942-type 6X20 LB buoy can have

a radar reflector added, giving it the appearance, at least in the superstructure, of the 1952-type buoy, and will have a 1952-type stock number assigned.

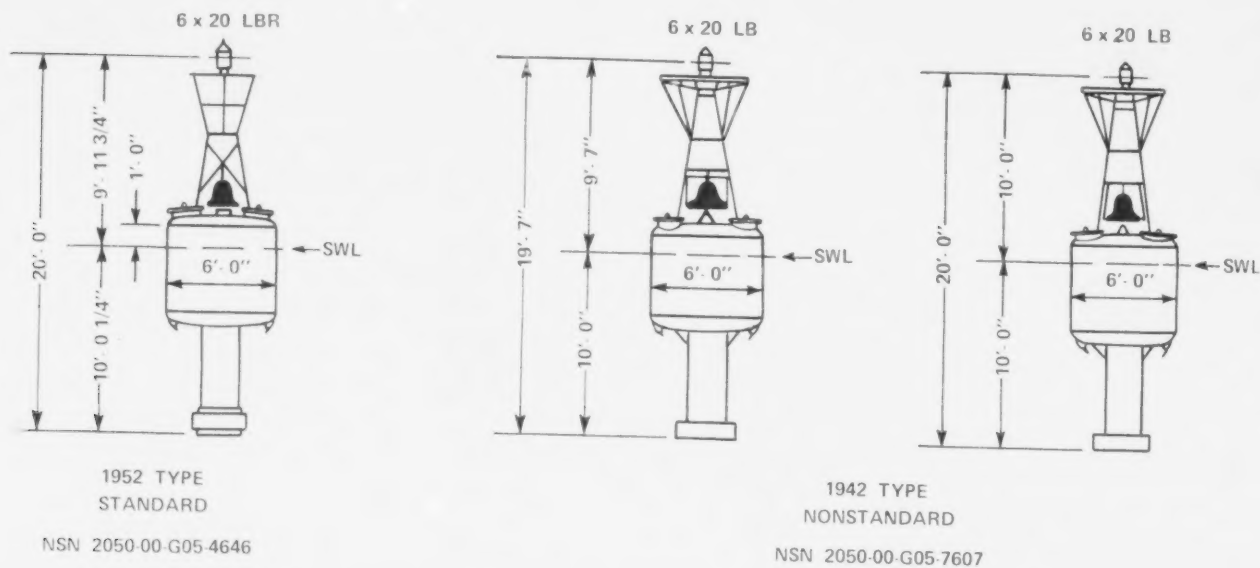


Figure 2-22. Standard and nonstandard substitutes.

5X18 LI



**1970 TYPE
STANDARD**

Function. The 5X18 LI buoy is designed and constructed for use as a seasonal aid on stations subjected to ice conditions.

Physical Characteristics

Buoy weight	2,770 lb
Buoy draft (no mooring)	8 ft-1 in.
Focal height of light (no mooring)	9 ft-10 1/8 in.
Freeboard (no mooring)	2 ft-0 in.
Minimum freeboard	1 ft-9 in.
Pounds per inch of immersion	105

Related Equipment

Power unit
Mooring chain size
Sinkers size

ice buoy pack
retain mooring on
aid being replaced,
but use 3/4 in.
riser chain

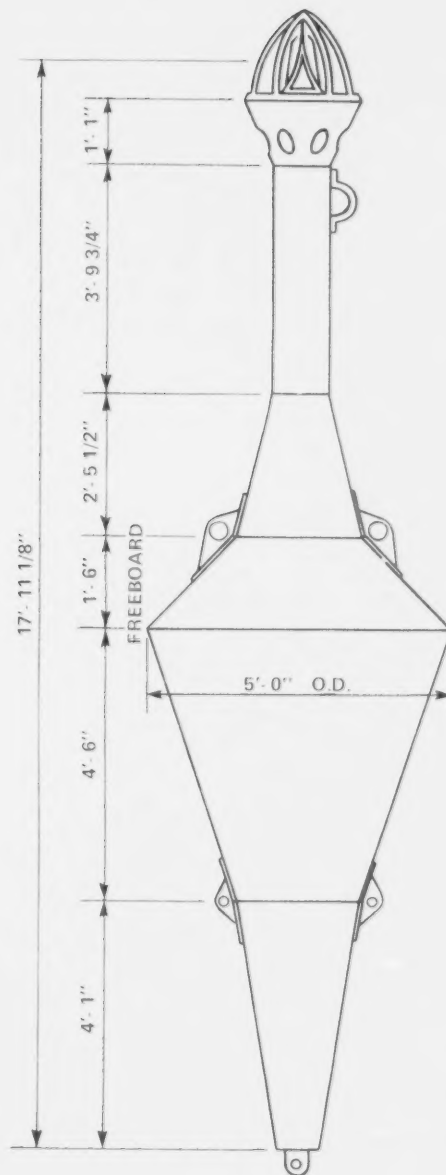


Figure 2-23. Dimensions of the 5X18 LI.

Data Sheet 2-D(12). 5X18 LI buoy.

Additional Data. Buoys with operational characteristics similar to the 1970-type

5X18 LI are shown in Figure 2-24.

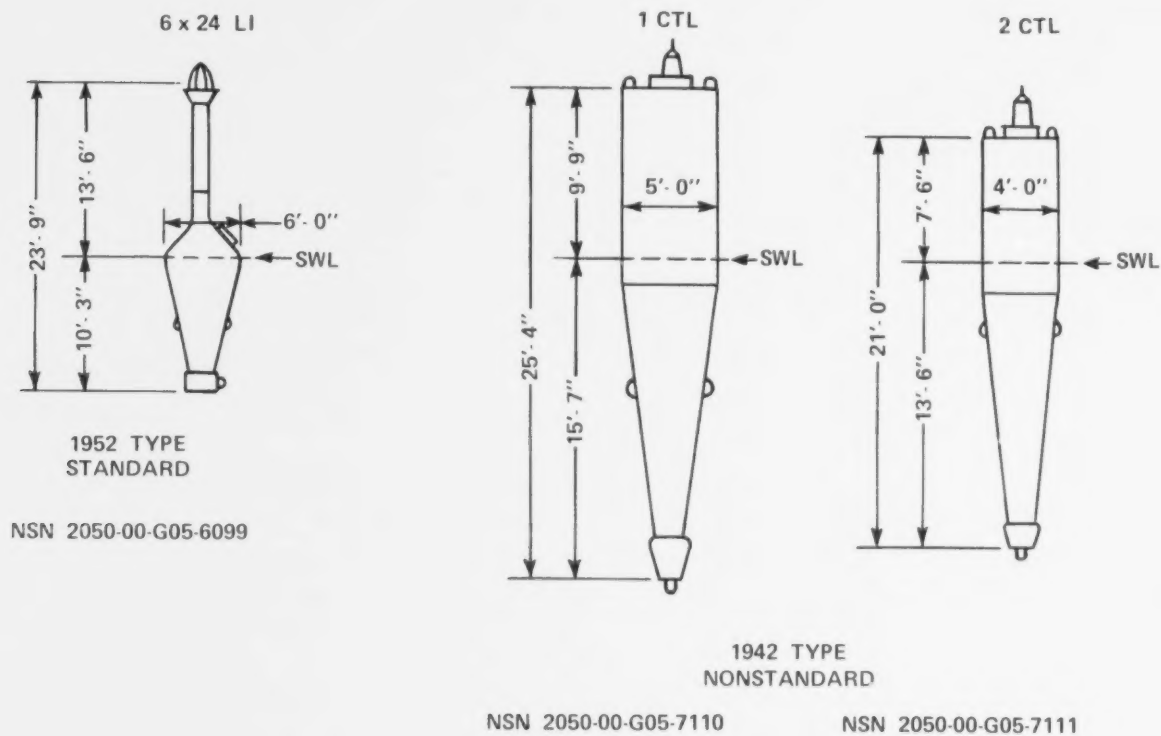
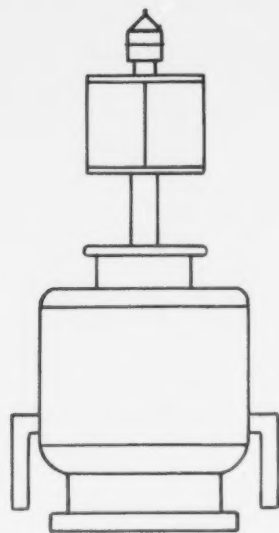


Figure 2-24. Standard and nonstandard substitutes.

5X11 LR

Operational Characteristics (cont'd)

Minimum mooring depth	10 ft
Maximum mooring depth (B10)	160 ft



1965 TYPE
STANDARD

Function. The 5X11 LR buoy is designed and constructed for protected locations. This buoy configuration cannot have a sound signal installed.

Physical Characteristics

Buoy weight	3,004 lb
Buoy draft (no mooring)	4 ft-1 in.
Focal height of light (no mooring)	7 ft-5 in.
Freeboard (no mooring)	2 ft-2 in.
Minimum freeboard	9 in.
Pounds per inch of immersion	105

Related Equipment

Power units (maximum number and size)	1-B10
Bridle size (chain diameter and length)	1 in.X12 ft
Mooring chain size	3/4 in.
Sinker size	4,000 lb

Operational Characteristics

Nominal visual range of daymark	1.4 nmi
Radar range	1.7 nmi
Maximum current	3 kn
Visual range of light	(see Chapter 6)

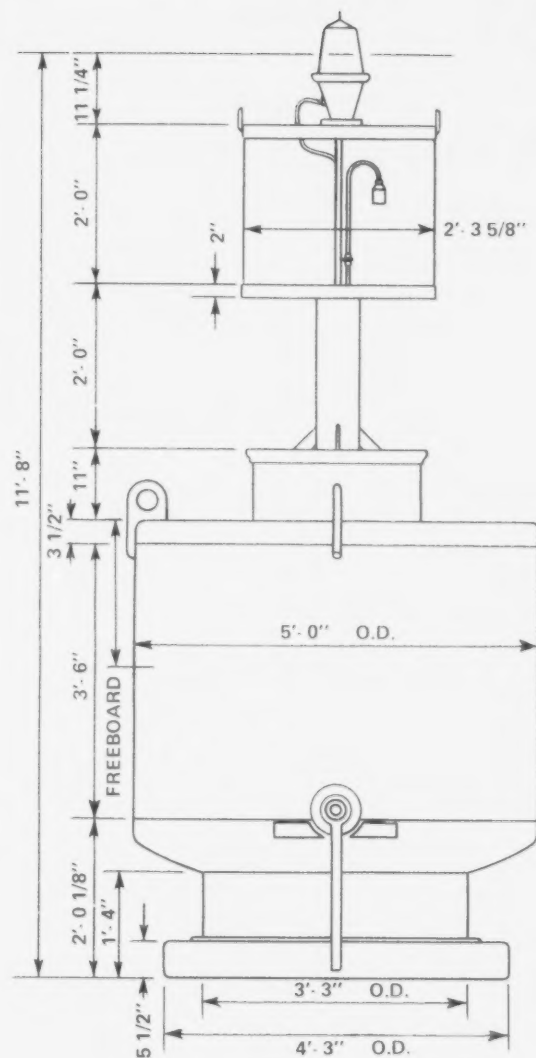


Figure 2-25. Dimensions of the 5X11 LR.

Data Sheet 2-D(13). 5X11 LR buoy.

Additional Data. Buoys with operational characteristics similar to the 1965-type 5X11 LR (the only buoy of this type presently manufactured) are shown in Figure 2-26. The 1942-type 5X10 L buoy can have a radar reflector added, giving it the appearance, at least in the superstructure, of the 1952-type buoy, and will have a

1952-type stock number assigned. Although not illustrated, the 1928-type 6X12 L (NSN 2050-00-G05-0712) and the 1942-type 5X12 LR (NSN 2050-00-G05-7007) also have operational characteristics similar to the 1965-type 5X11 LR buoy. (The 6X12 L is the old 6½ FE.)

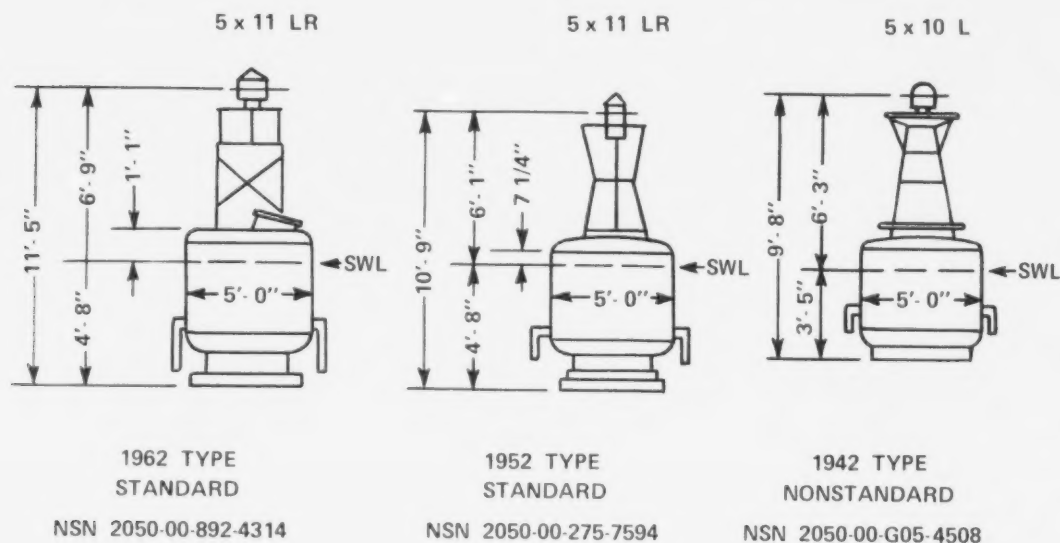
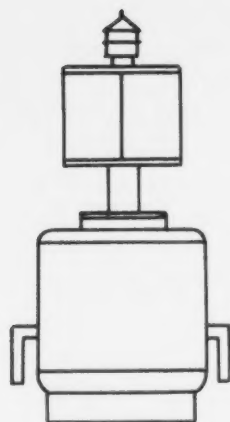


Figure 2-26. Standard and nonstandard substitutes.

3½X8 LR



**1965 TYPE
STANDARD**

Function. The 3½X8 LR buoy is designed and constructed for protected locations. This buoy configuration cannot have a sound signal installed.

Physical Characteristics

Buoy weight	1,487 lb
Buoy draft (no mooring)	2 ft-9 in.
Focal height of light (no mooring)	5 ft-6 in.
Freeboard (no mooring)	1 ft-4 in.
Minimum freeboard	6 in.
Pounds per inch of immersion	50

Related Equipment

Power units (maximum number and size)	1-B10
Bridle size (chain diameter and length)	7/8 in.X10 ft
Mooring chain size	3/4 in.
Sinker size	3,000 lb

Operational Characteristics

Nominal visual range of daymark	1.4 nmi
Radar range	1.3 nmi
Maximum current	3 kn
Visual range of light	(see Chapter 6)

Operational Characteristics (cont'd)

Minimum mooring depth	10 ft
Maximum mooring depth (B10)	30 ft

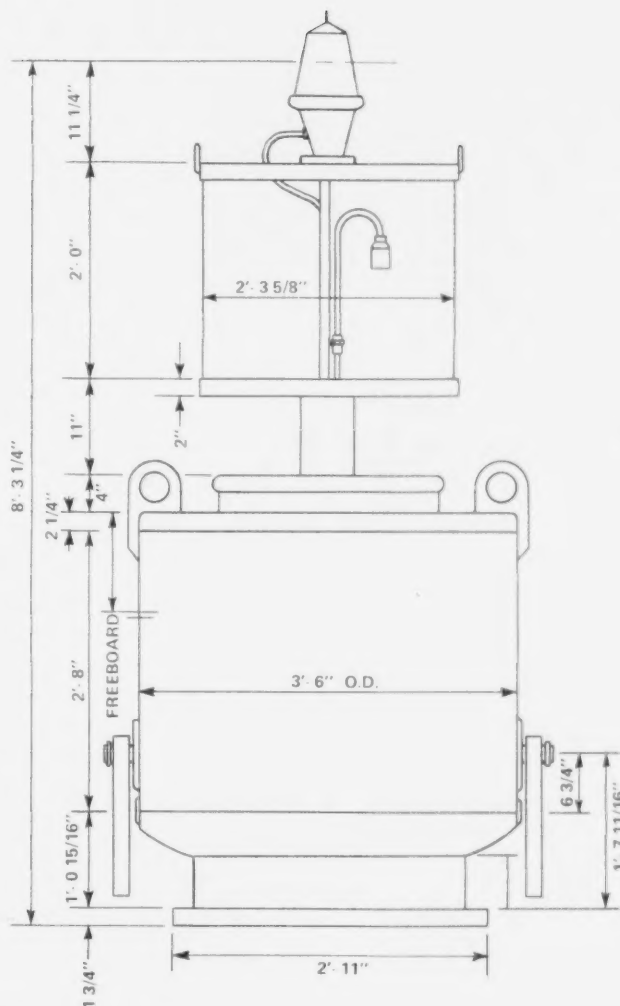


Figure 2-27. Dimensions of the 3½X8 LR.

Data Sheet 2-D(14). 3½X8 LR buoy.

Additional Data. Buoys with operational characteristics similar to the 1965-type 3 1/2 X 8 LR (the only buoy of this type presently manufactured) are shown in Figure

2-28. Radar reflectors should not be added to these buoys because they would cause them to be unstable.

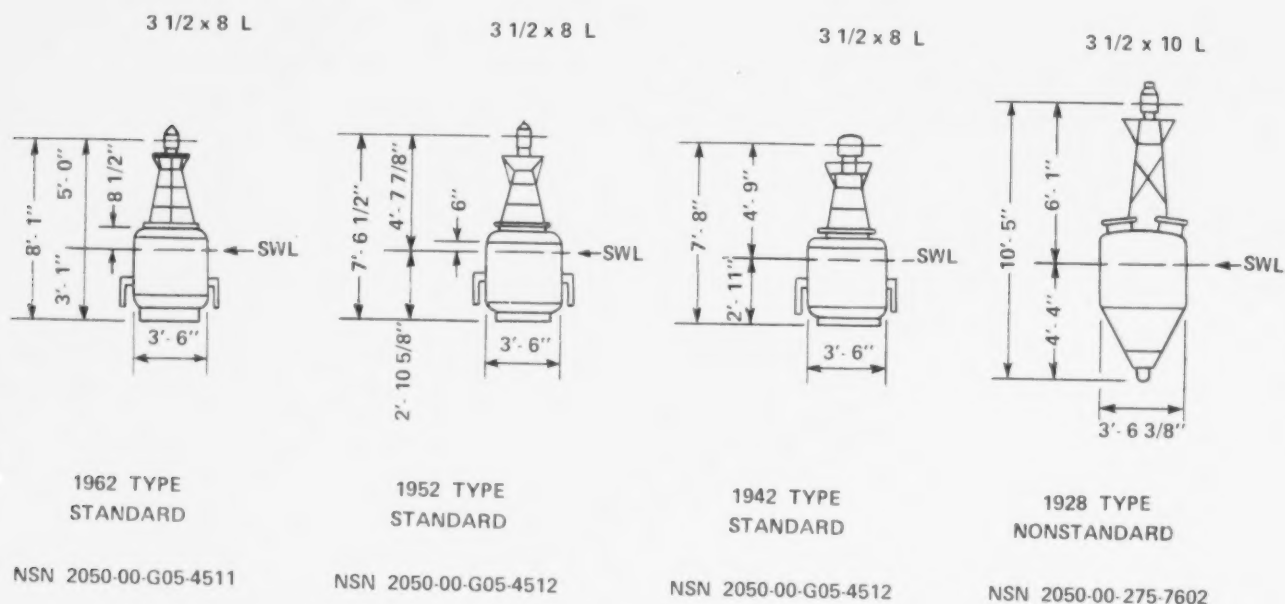
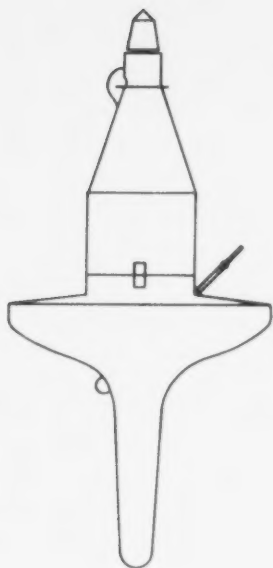


Figure 2-28. Standard and nonstandard substitutes.

DISCREPANCY BUOY



Function. The discrepancy buoy is designed to temporarily replace damaged or missing buoys or structures until the discrepancy can be corrected.

Physical Characteristics

Buoy weight	220 lb
Buoy draft (no mooring)	4 ft
Focal height of light (no mooring)	4 ft-6 in.

Related Equipment

Power units	"hot-shot"
Mooring chain size	$\frac{1}{2}$ in.
Sinker size	150-250 lb

Operational Characteristics

Nominal visual range of daymark	1 nmi
Radar range	1 nmi
Maximum current	5 kn
Visual range of light	(see Chapter 6)
Minimum mooring depth	5 ft
Maximum mooring depth	100 ft

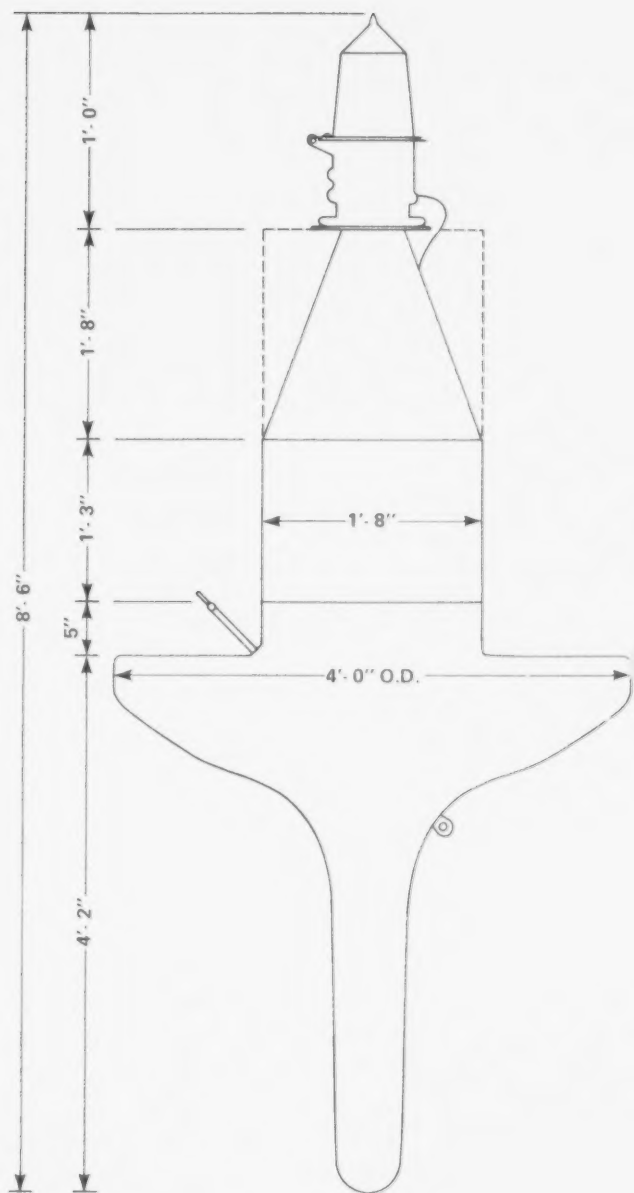
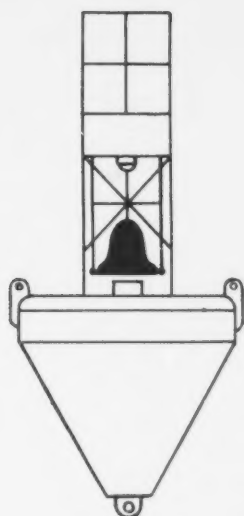


Figure 2-29. Dimensions of the discrepancy buoy.

Data Sheet 2-D(15). Discrepancy buoy

9X20 BR



1962 TYPE
STANDARD

Function. The 9X20 BR buoy is designed and constructed for exposed locations where a lighted buoy is not necessary. This buoy configuration is used with a 225-lb bell, wave-actuated sound signal.

Physical Characteristics

Buoy weight	8,110 lb
Buoy draft (no mooring)	5 ft-5 in.
Freeboard (no mooring)	2 ft-0 in.
Minimum freeboard	9 in.
Pounds per inch of immersion	340

Related Equipment

Sound equipment	225-lb bell
Bridle size (chain diameter and length)	1½ in.X15 ft
Mooring chain size	1½ in.
Sinker size	5,000 lb

Operational Characteristics

Nominal visual range of daymark	3 nmi
Radar range	3.7 nmi
Maximum current	4 kn
Minimum mooring depth	15 ft
Maximum mooring depth	200 ft

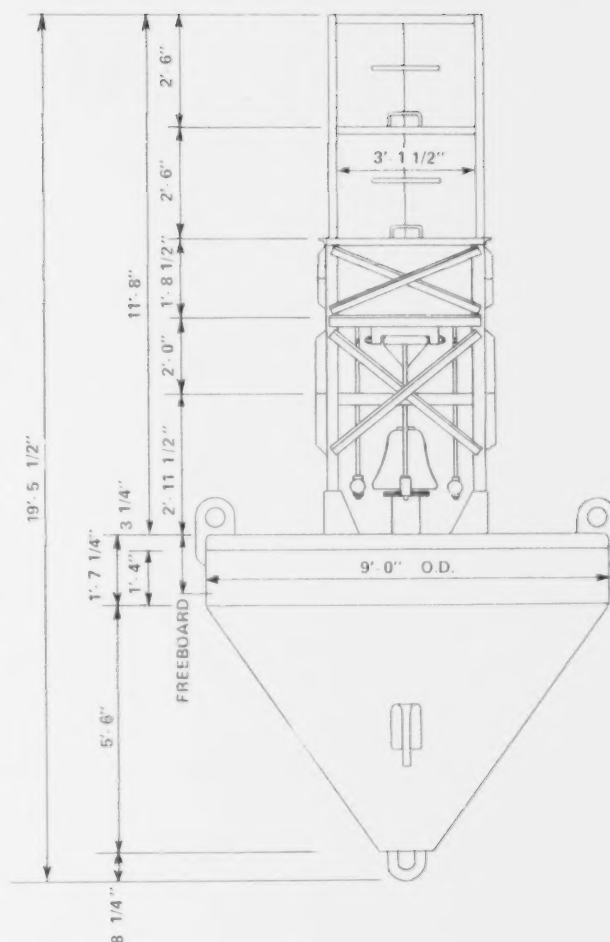


Figure 2-30. Dimensions of the 9X20 BR.

Data Sheet 2-D(16). 9X20 BR buoy.

Additional Data. Buoys with operational characteristics similar to the 1962-type 9X20 BR (the only buoy of this type presently manufactured) are shown in Figure

2-31. Both the 1942-type 9X13 B and 8X13 B buoys have a minimum mooring weight of 2600 lb.

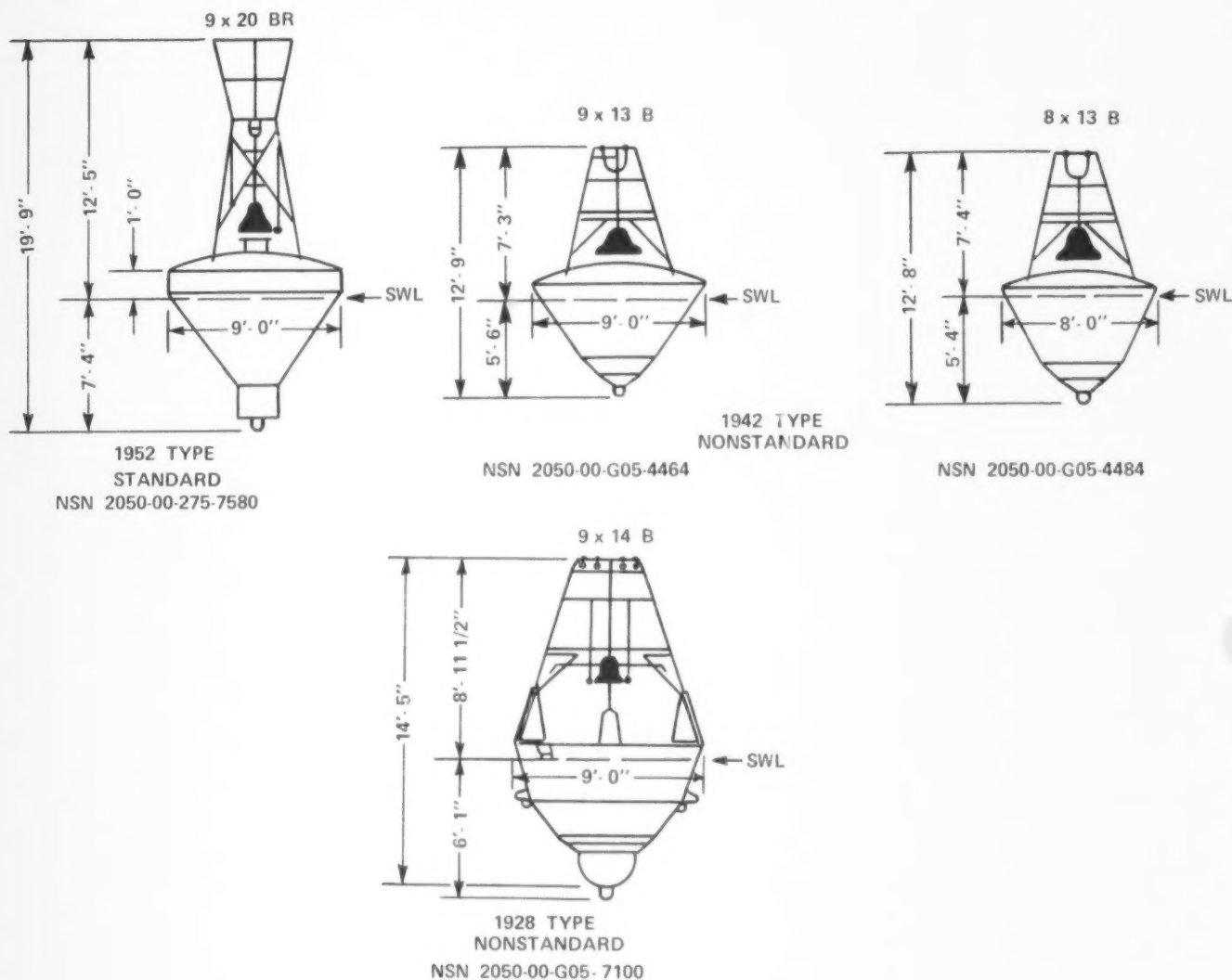
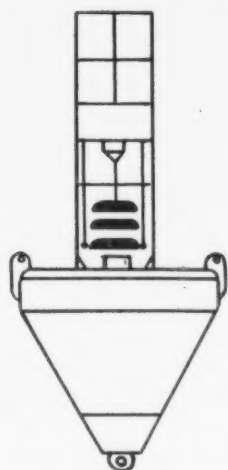


Figure 2-31. Standard and nonstandard substitutes.

9X20 GR



1962 TYPE
STANDARD

Function. The 9X20 GR buoy is designed and constructed for exposed locations where a lighted buoy is not necessary. This buoy configuration is used with a 20-in. diameter, three-gong, wave-actuated sound signal.

Physical Characteristics

Buoy weight	8,110 lb
Buoy draft (no mooring)	5 ft-5 in.
Freeboard (no mooring)	2 ft-0 in.
Minimum freeboard	9 in.
Pounds per inch of immersion	340

Related Equipment

Sound equipment	3 20-in. gongs
Bridle size (chain diameter and length)	1 1/4 in. X 15 ft
Mooring chain size	1 1/4 in.
Sinker size	5,000 lb

Operational Characteristics

Nominal visual range of daymark	3 nmi
Radar range	3.7 nmi
Maximum current	4 kn
Minimum mooring depth	15 ft
Maximum mooring depth	200 ft

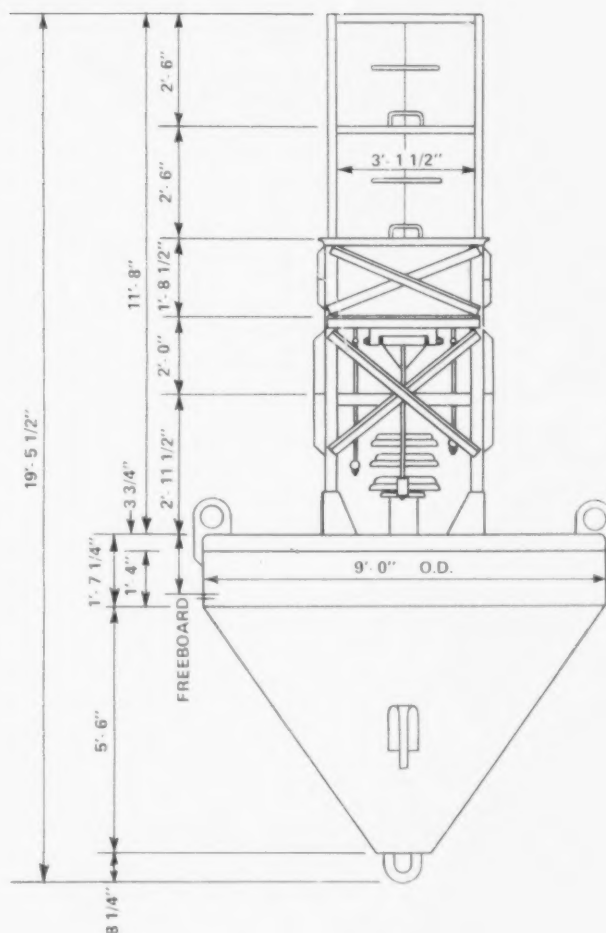


Figure 2-32. Dimensions of the 9X20 GR.

Data Sheet 2-D(17). 9X20 GR buoy.

Additional Data. Buoys with operational characteristics similar to the 1962-type 9X20 GR (the only buoy of this type presently manufactured) are shown in Figure

2-33. Both the 1942-type 9X13 G and 8X13 G buoys have a minimum mooring weight of 2600 lb.

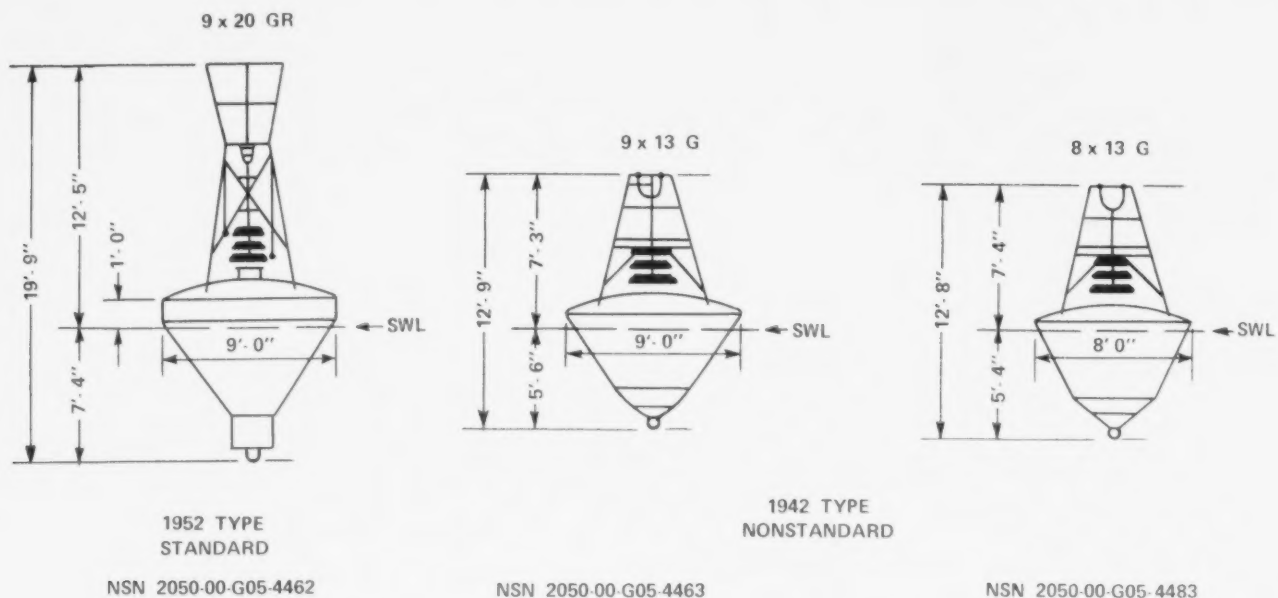
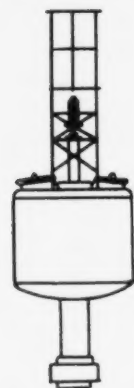


Figure 2-33. Standard and nonstandard substitutes.

8X26 WR

Operational Characteristics (cont'd)

Minimum mooring depth	25 ft
Maximum mooring depth	117 ft



1962 TYPE
STANDARD

Function. The 8X26 WR buoy is designed and constructed for exposed or semiexposed locations. It is the same as the 8X26 LWR (Data Sheet 2-D(8)), except that the lighting equipment is not installed. This buoy configuration is used with a four-ball whistle and whistle valve for the wave-actuated sound signal.

Physical Characteristics

Buoy weight	12,131 lb
Buoy draft (no mooring)	10 ft-9 in.
Freeboard (no mooring)	2 ft-2 in.
Minimum freeboard	1 ft-3 in.
Pounds per inch of immersion	250

Related Equipment

Sound equipment	4-ball whistle
Bridle size (chain diameter and length)	1 1/4 in. X 15 ft
Mooring chain size	1 1/4 in.
Sinker size	8,500 lb

Operational Characteristics

Nominal visual range of daymark	3.2 nmi
Radar range	3.7 nmi
Maximum current	4 kn

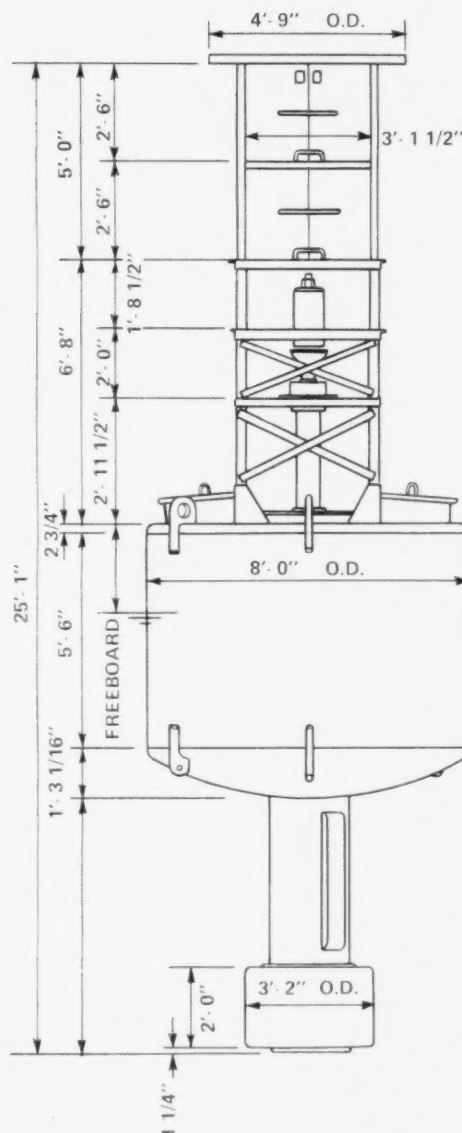


Figure 2-34. Dimensions of the 8X26 WR.

Data Sheet 2-D(18). 8X26 WR buoy.

Additional Data. Buoys with operational characteristics similar to the 1962-type 8X26 WR (the only buoy of this type presently manufactured) are shown in Figure 2-35. Both the 1942-type 8X26 W and the

1928-type 8X23 W buoys can have a radar reflector added, giving them the appearance of the 1952-type buoy, and will have a 1952-type stock number assigned.

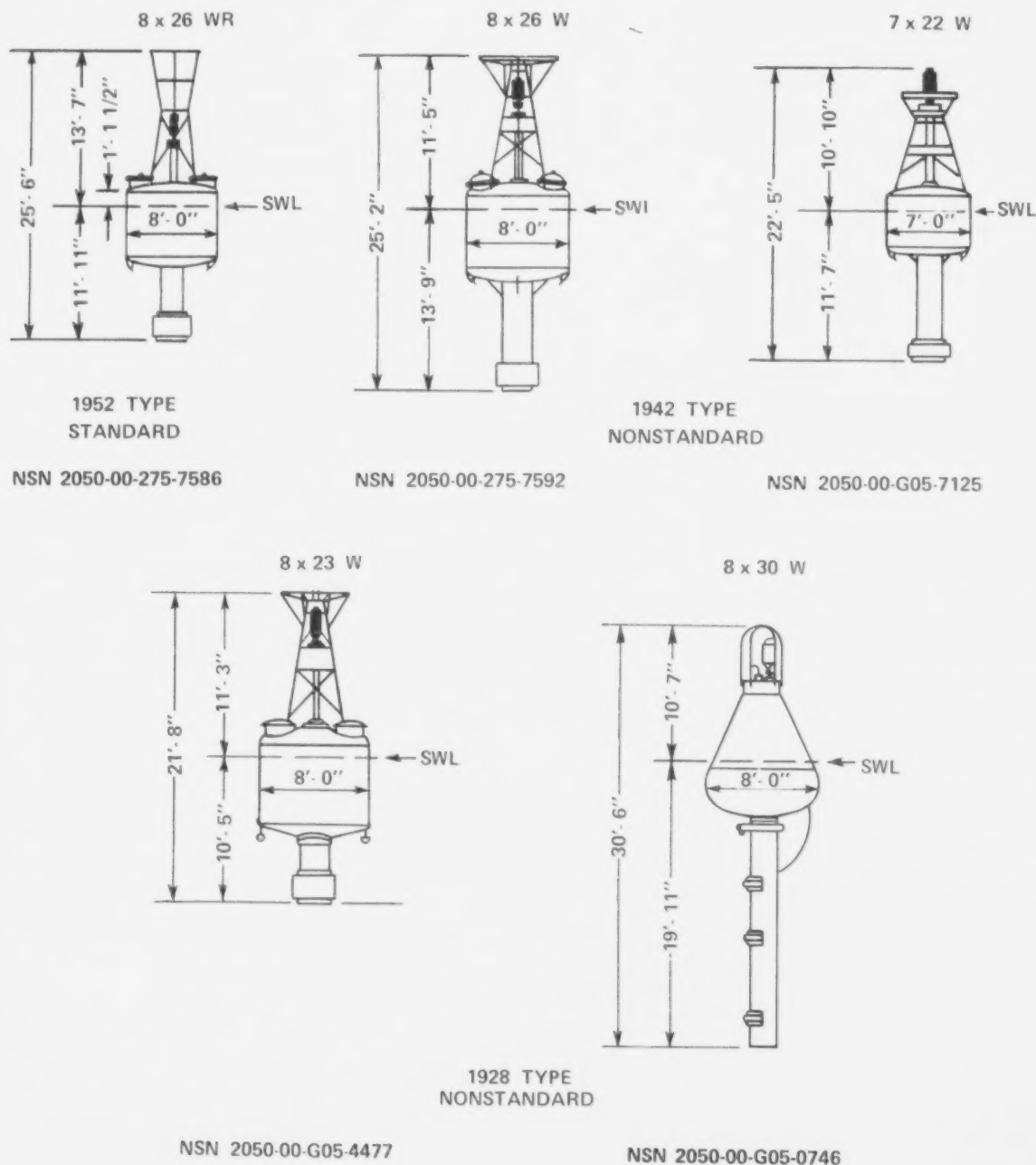
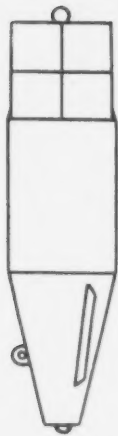


Figure 2-35. Standard and nonstandard substitutes.

Data Sheet 2-D(18). (cont'd).



1952 TYPE STANDARD

Function. The 1 CR buoy is designed and constructed for the most exposed locations, where an unlighted CAN buoy is required.

Physical Characteristics

Buoy weight	5,600 lb
Buoy draft (no mooring)	8 ft-0 in.
Freeboard (no mooring)	6 ft-0 in.
Minimum freeboard	2 ft-5 in.
Pounds per inch of immersion	105

Related Equipment

Mooring chain size	1 1/8 in.
Sinker size	5,000 lb

Operational Characteristics

Nominal visual range of daymark	3.8 nmi
Radar range	3.5 nmi
Maximum current	6 kn
Minimum mooring depth	15 ft
Maximum mooring depth	236 ft

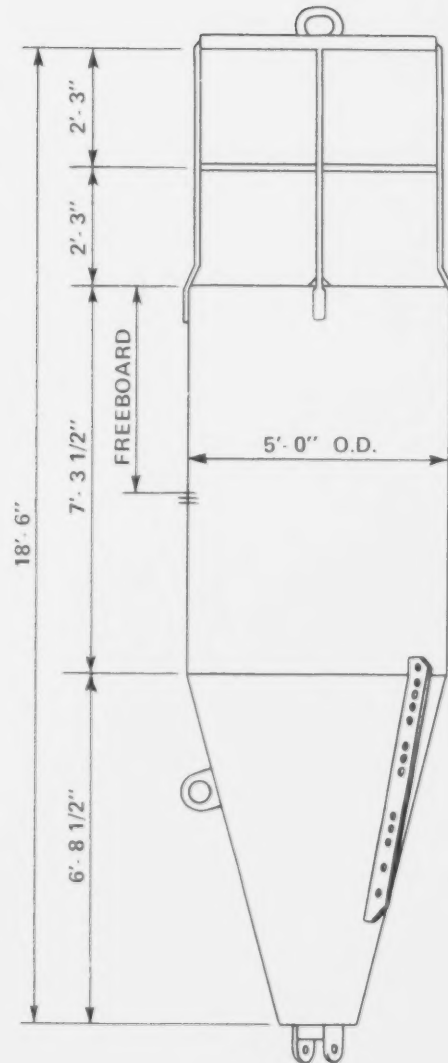


Figure 2-36. Dimensions of the 1 CR.

Data Sheet 2-D(19). 1 CR buoy.

Additional Data. Buoys with operational characteristics similar to the 1952-type 1 CR are shown in Figure 2-37. The 1928-

type 1 C has a minimum mooring weight of 2000 lb.

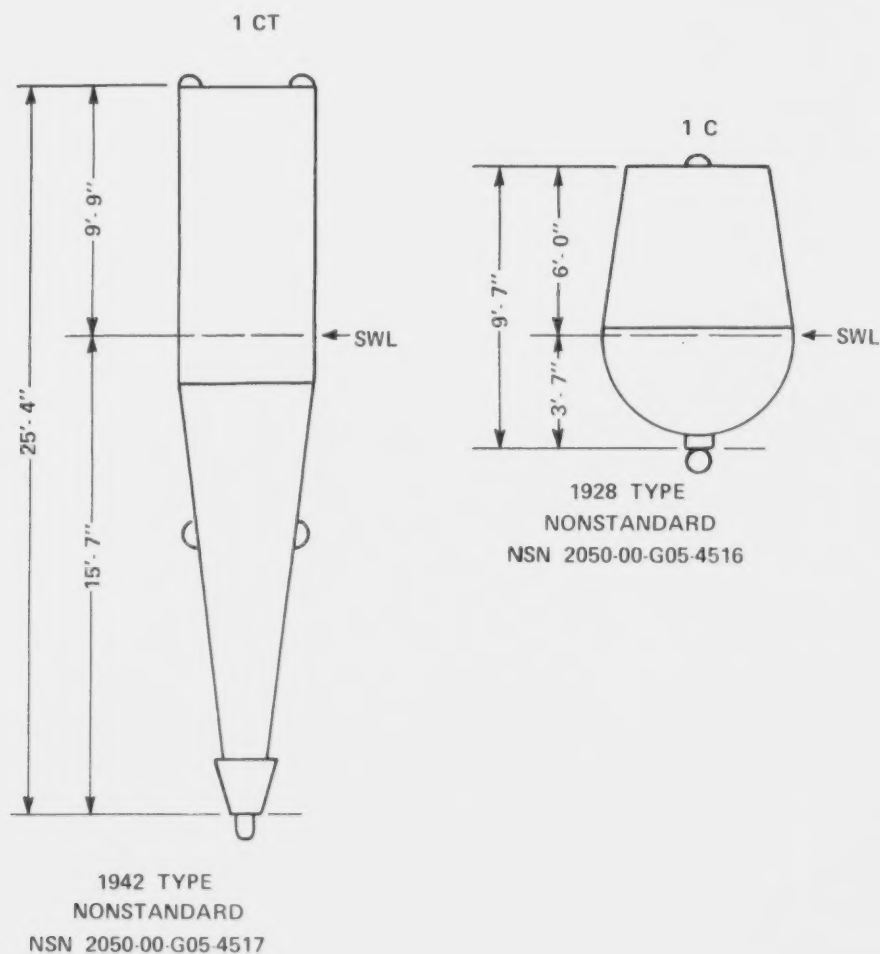


Figure 2-37. Nonstandard substitutes.

1 NR



**1952 TYPE
STANDARD**

Function. The 1 NR buoy is designed and constructed for the most exposed locations, where an unlighted NUN buoy is required.

Physical Characteristics

Buoy weight	5,400 lb
Buoy draft (no mooring)	7 ft-11 in.
Freeboard (no mooring)	6 ft-1 in.
Minimum freeboard	2 ft-5 in.
Pounds per inch of immersion	105

Related Equipment

Mooring chain size	1 1/8 in.
Sinker size	5,000 lb

Operational Characteristics

Nominal visual range of daymark	3.5 nmi
Radar range	3.5 nmi
Maximum current	6 kn
Minimum mooring depth	15 ft
Maximum mooring depth	241 ft

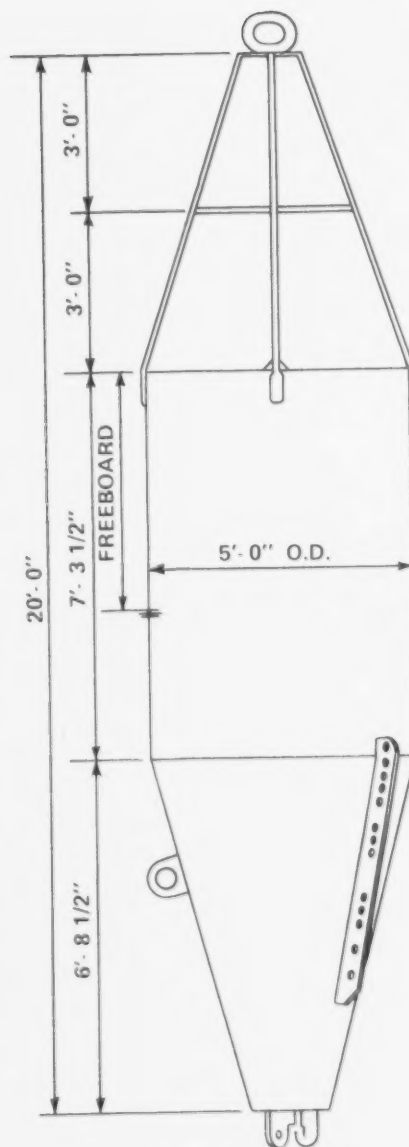


Figure 2-38. Dimensions of the 1 NR.

Data Sheet 2-D(20). 1 NR buoy.

Additional Data. Buoys with operational characteristics similar to the 1952-type 1 NR are shown in Figure 2-39. The 1928-

type 1 N has a minimum mooring weight of 2000 lb.

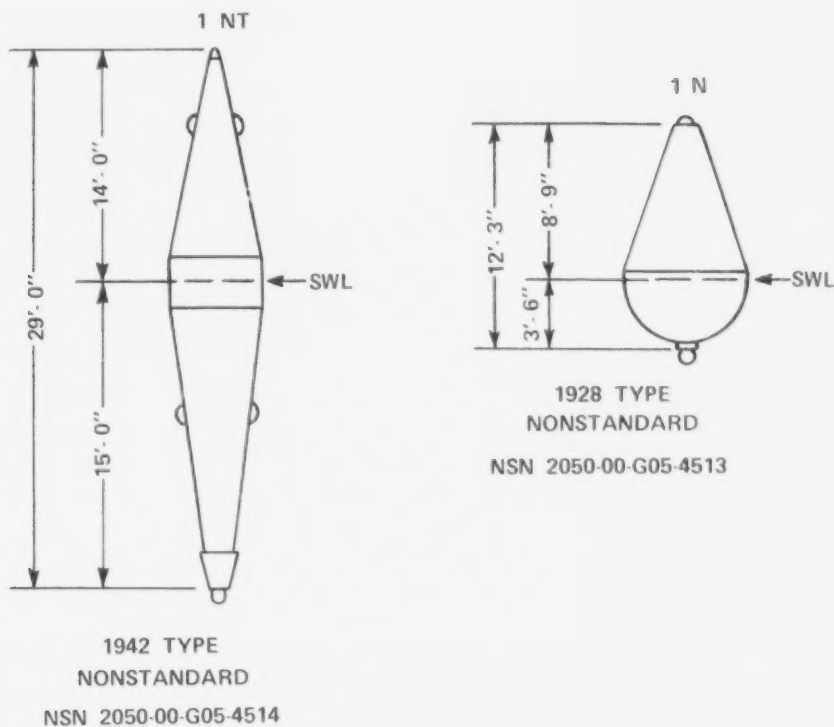


Figure 2-39. Nonstandard substitutes.



1952 TYPE
STANDARD

Function. The 2 CR buoy is designed and constructed for exposed or semiexposed locations, where an unlighted CAN buoy is required.

Physical Characteristics

Buoy weight	2,700 lb
Buoy draft (no mooring)	6 ft-1 in.
Freeboard (no mooring)	3 ft-11 in.
Minimum freeboard	1 ft-0 in.
Pounds per inch of immersion	67

Related Equipment

Mooring chain size	7/8 in.
Sinker size	4,000 lb

Operational Characteristics

Nominal visual range of daymark	2.8 nmi
Radar range	2.5 nmi
Maximum current	6 kn
Minimum mooring depth	15 ft
Maximum mooring depth	200 ft

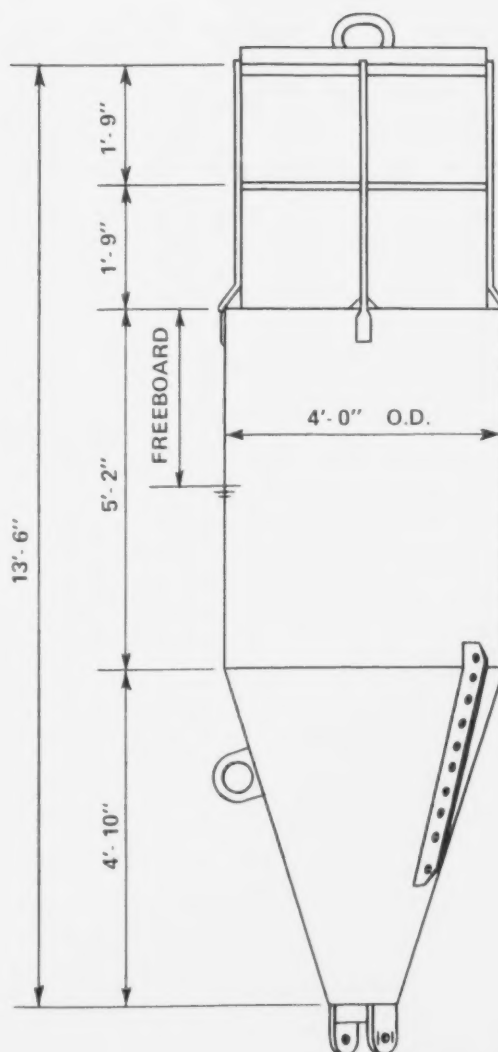


Figure 2-40. Dimensions of the 2 CR.

Data Sheet 2-D(21). 2 CR buoy

Additional Data. Buoys with operational characteristics similar to the 1952-type 2 CR are shown in Figure 2-41. The 1928-

type 2 C has a minimum mooring weight of 410 lb.

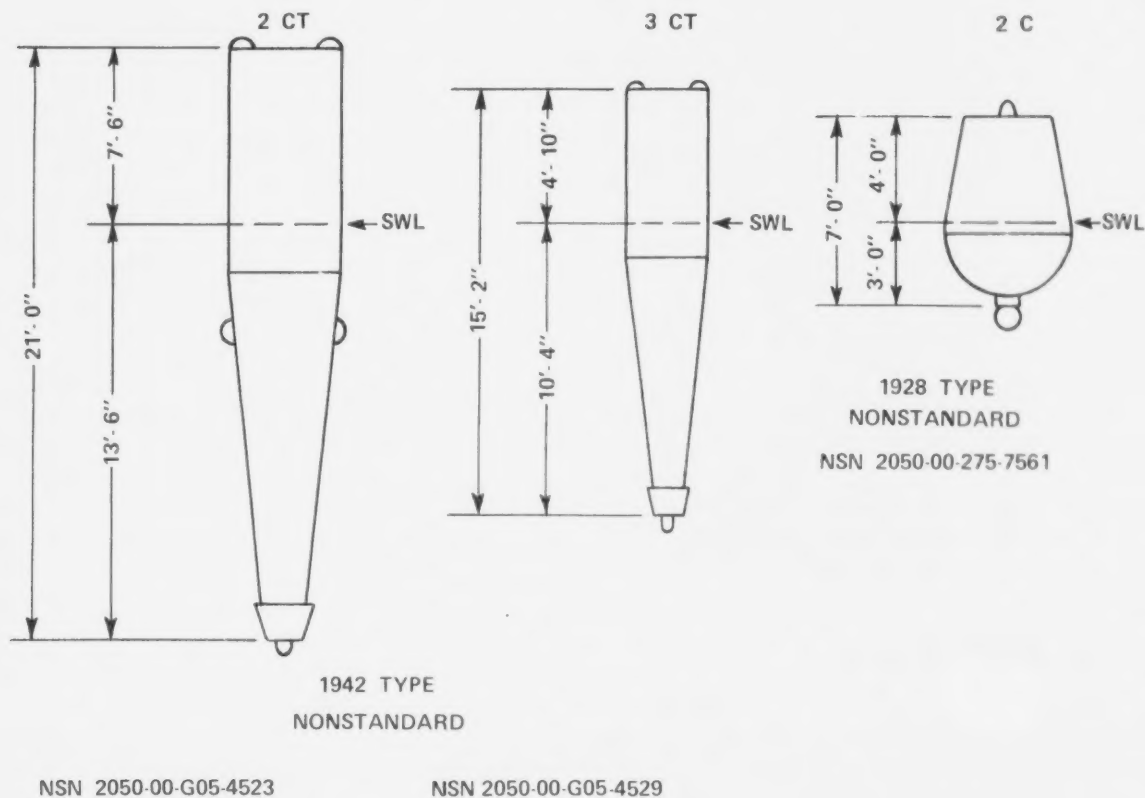


Figure 2-41. Nonstandard substitutes.

2 NR



1952 TYPE
STANDARD

Function. The 2 NR buoy is designed and constructed for exposed or semiexposed locations, where an unlighted NUN buoy is required.

Physical Characteristics

Buoy weight	2,600 lb
Buoy draft (no mooring)	6 ft-0 in.
Freeboard (no mooring)	4 ft-0 in.
Minimum freeboard	1 ft-0 in.
Pounds per inch of immersion	67

Related Equipment

Mooring chain size	7/8 in.
Sinker size	4,000 lb

Operational Characteristics

Nominal visual range of daymark	2.6 nmi
Radar range	3 nmi
Maximum current	6 kn
Minimum mooring depth	15 ft
Maximum mooring depth	205 ft

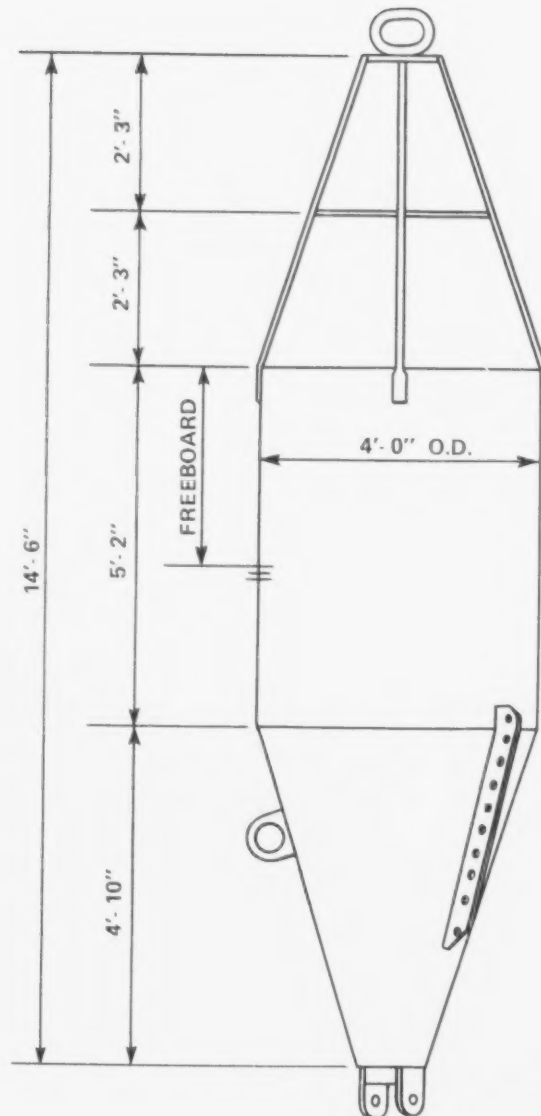


Figure 2-42. Dimensions of the 2 NR.

Data Sheet 2-D(22). 2 NR buoy.

Additional Data. Buoys with operational characteristics similar to the 1952-type 2 NR are shown in Figure 2-43. The 1928-

type 2 N has a minimum mooring weight of 410 lb.

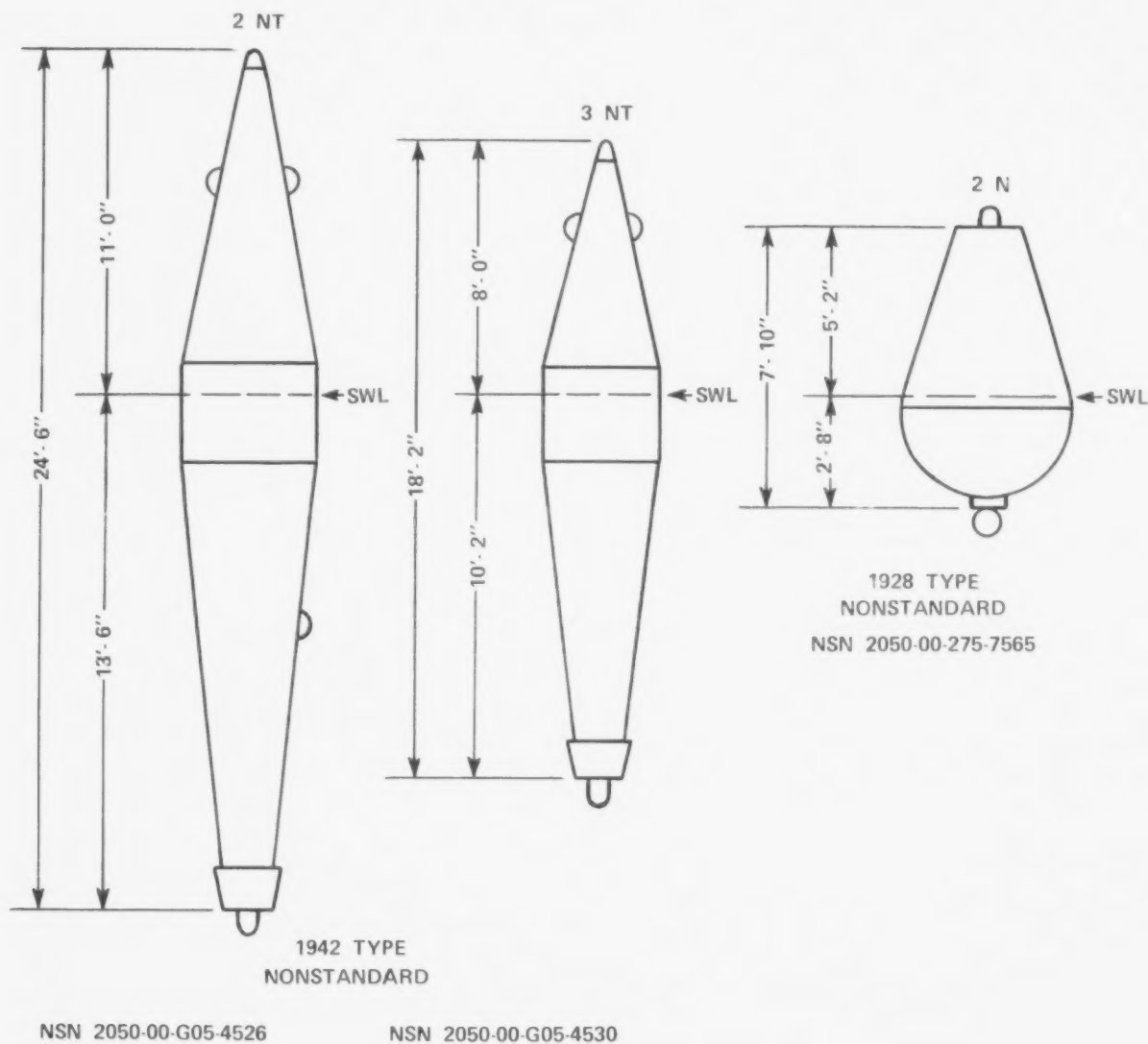


Figure 2-43. Nonstandard substitutes.



1952 TYPE
STANDARD

Function. The 3 CR buoy is designed and constructed for semiexposed or protected locations, where an unlighted CAN buoy is required.

Physical Characteristics

Buoy weight	955 lb
Buoy draft (no mooring)	4 ft-0 in.
Freeboard (no mooring)	2 ft-8 in.
Minimum freeboard	9 in.
Pounds per inch of immersion	38

Related Equipment

Mooring chain size	3/4 in.
Sinker size	3,000 lb

Operational Characteristics

Nominal visual range of daymark	1.4 nmi
Radar range	1.5 nmi
Maximum current	5 kn
Minimum mooring depth	10 ft
Maximum mooring depth	102 ft

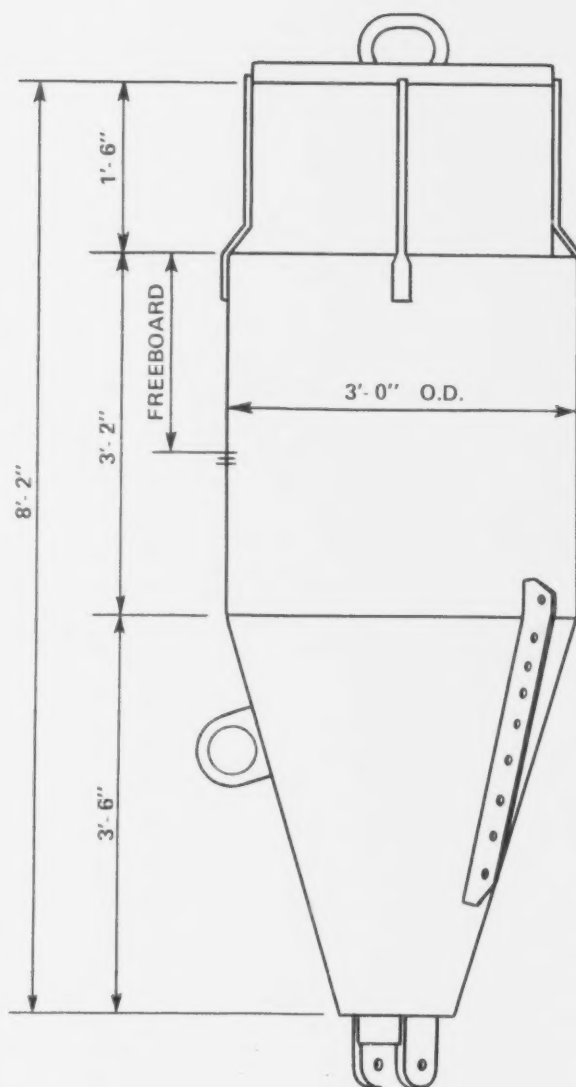


Figure 2-44. Dimensions of the 3 CR.

Data Sheet 2-D(23). 3 CR buoy.

Additional Data. Buoys with operational characteristics similar to the 1952-type 3 CR are shown in Figure 2-45. The 1928-

type 3 C has a minimum mooring weight of 120 lb.

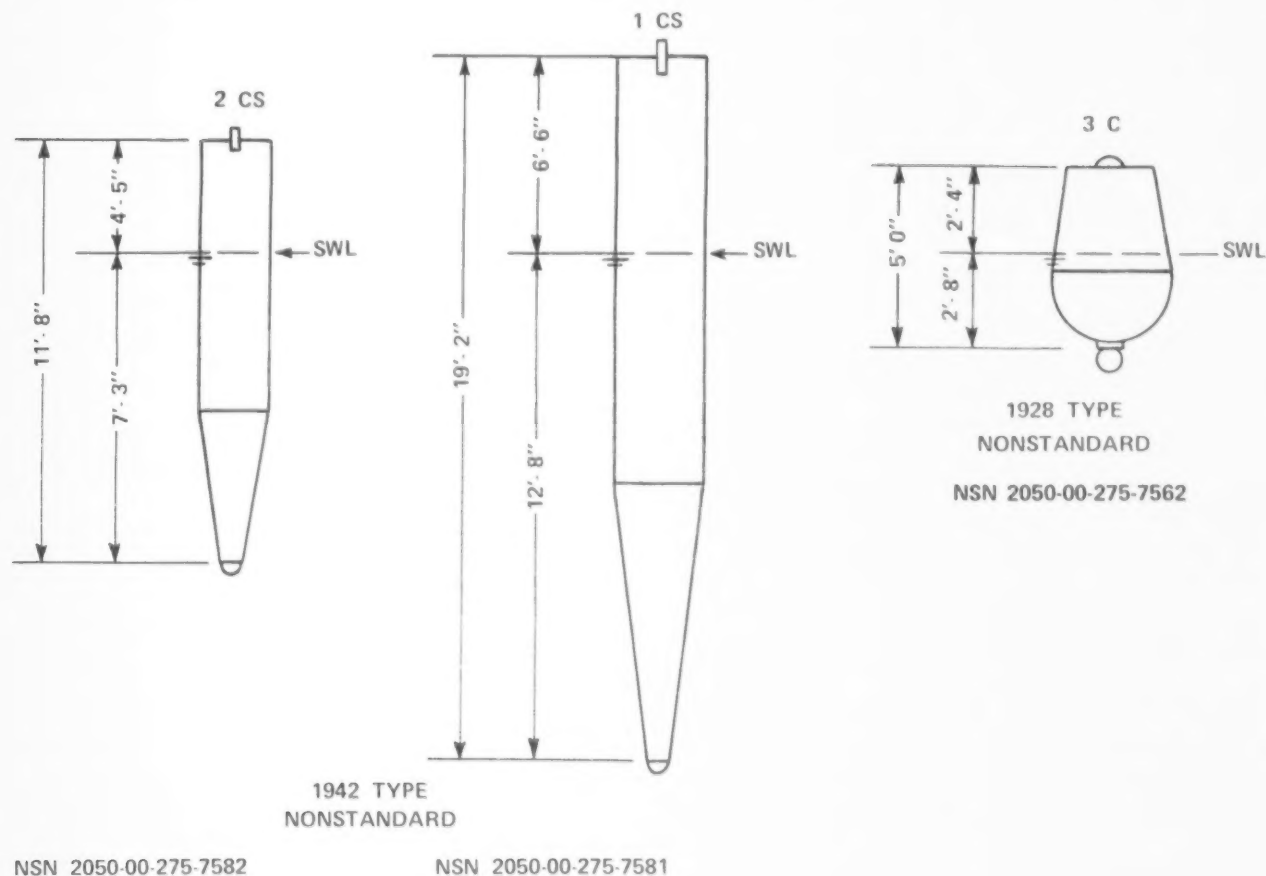
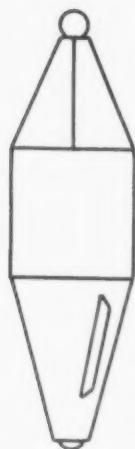


Figure 2-45. Nonstandard substitutes.



**1952 TYPE
STANDARD**

Function. The 3 NR buoy is designed and constructed for semiexposed or protected locations, where an unlighted NUN buoy is required.

Physical Characteristics

Buoy weight	935 lb
Buoy draft (no mooring)	3 ft-11 in.
Freeboard (no mooring)	2 ft-9 in.
Minimum freeboard	9 in.
Pounds per inch of immersion	38

Related Equipment

Mooring chain size	3/4 in.
Sinker size	3,000 lb

Operational Characteristics

Nominal visual range of daymark	1.4 nmi
Radar range	1.75 nmi
Maximum current	5 kn
Minimum mooring depth	10 ft
Maximum mooring depth	107 ft

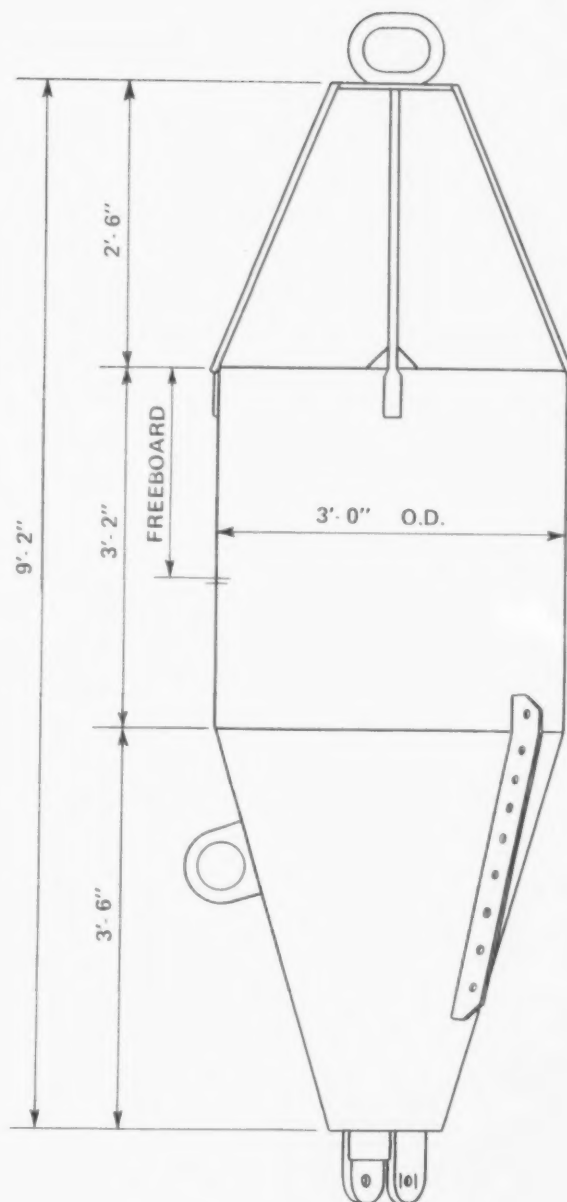


Figure 2-46. Dimensions of the 3 NR.

Data Sheet 2-D(24). 3 NR buoy.

Additional Data. Buoys with operational characteristics similar to the 1952-type 3 NR are shown in Figure 2-47. The 1928-

type 3 N has a minimum mooring weight of 120 lb.

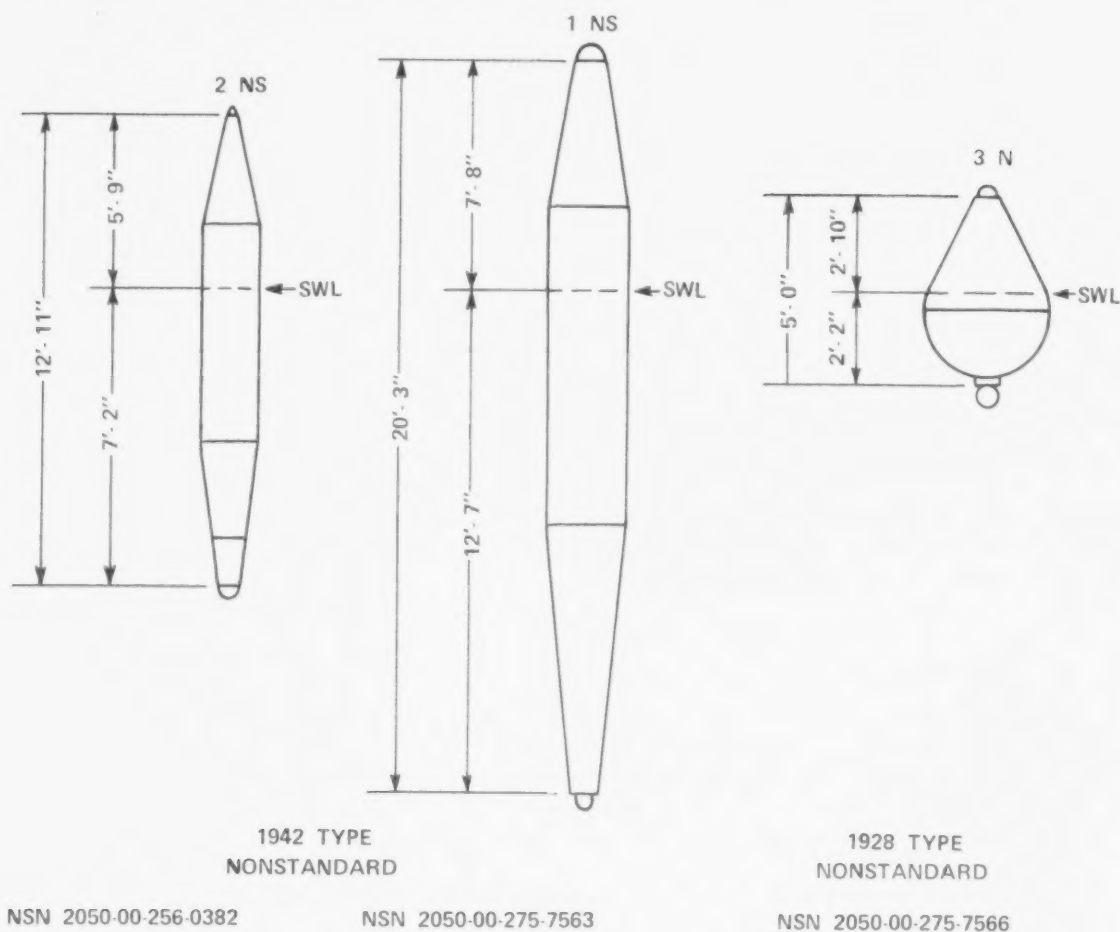
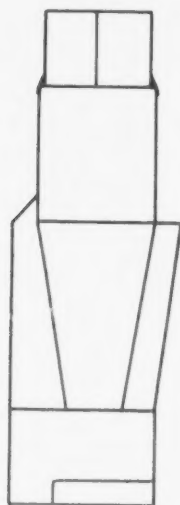


Figure 2-47. Nonstandard substitutes.



1952 TYPE
STANDARD

Function. The 4 CR buoy is designed and constructed for river environments and protected locations, where an unlighted CAN buoy is required. This buoy is foam filled.

Physical Characteristics

Buoy weight	465 lb
Buoy draft (no mooring)	5 ft-0 in.
Freeboard (no mooring)	2 ft-11 in.
Minimum freeboard	1 ft-0 in.
Pounds per inch of immersion	21

Related Equipment

Mooring chain size	7/16 or $\frac{1}{2}$ in.
Mooring wire rope size	$\frac{1}{2}$ in.
Sinker size	2,000 lb

Operational Characteristics

Nominal visual range of daymark	1.4 nmi
Radar range	1.5 nmi
Maximum current	5 kn
Minimum mooring depth	10 ft
Maximum mooring depth	132 ft

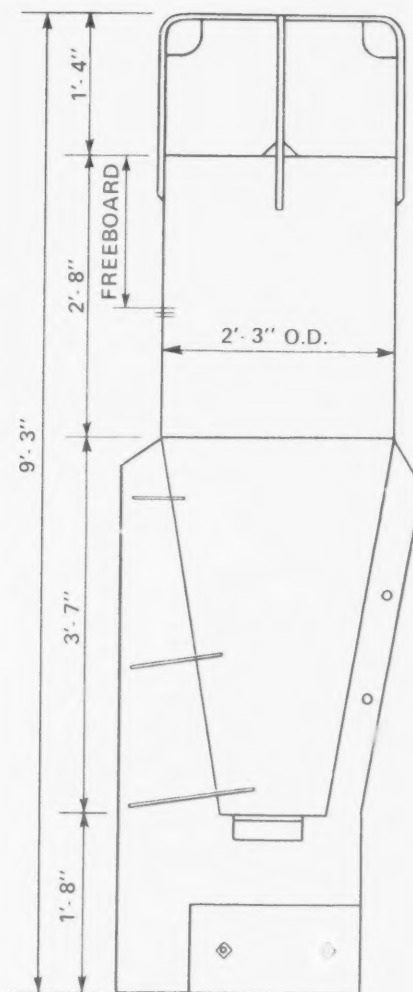
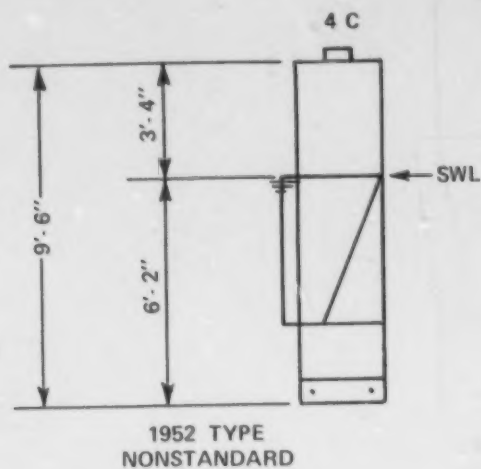


Figure 2-48. Dimensions of the 4 CR.

Data Sheet 2-D(25). 4 CR buoy

Additional Data. A buoy with operational characteristics similar to the 1952 4 CR

radar reflector type is shown in Figure 2-49.



NSN 2050-00-G05-4536

Figure 2-49. Nonstandard substitute.

Data Sheet 2-D(25). (cont'd).



1952 TYPE
STANDARD

Function. The 4 NR buoy is designed and constructed for river environments and protected locations, where an unlighted NUN buoy is required. This buoy is foam filled.

Physical Characteristics

Buoy weight	470 lb
Buoy draft (no mooring)	5 ft-0 in.
Freeboard (no mooring)	2 ft-8 in.
Minimum freeboard	1 ft-0 in.
Pounds per inch of immersion	21

Related Equipment

Mooring chain size	7/16 or $\frac{1}{2}$ in.
Mooring wire rope size	$\frac{1}{2}$ in.
Sinker size	2,000 lb

Operational Characteristics

Nominal visual range of daymark	1.4 nmi
Radar range	1.5 nmi
Maximum current	5 kn
Minimum mooring depth	10 ft
Maximum mooring depth	115 ft

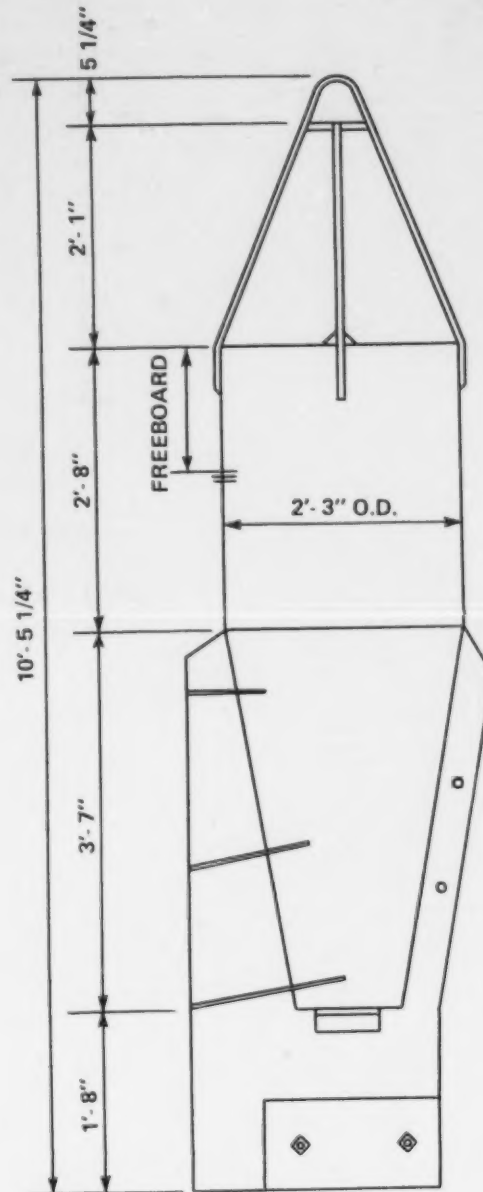
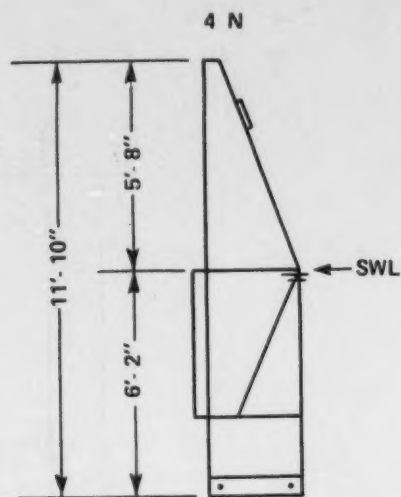


Figure 2-50. Dimensions of the 4 NR.

Data Sheet 2-D(26). 4 NR buoy.

Additional Data. A buoy with operational characteristics similar to the 1952 4 NR

radar reflector type is shown in Figure 2-51.



1952 TYPE
NONSTANDARD

NSN 2050-00-G05-4538

Figure 2-51. Nonstandard substitute.



1952 TYPE
STANDARD

Function. The 5 CR buoy is designed and constructed for protected locations, where an unlighted CAN buoy is required.

Physical Characteristics

Buoy weight	675 lb
Buoy draft (no mooring)	4 ft-10 in.
Freeboard (no mooring)	2 ft-6 in.
Minimum freeboard	6 in.
Pounds per inch of immersion	16

Related Equipment

Mooring chain size	7/16 or 1/2 in.
Sinker size	2,000 lb

Operational Characteristics

Nominal visual range of daymark	1 nmi
Radar range	1.25 nmi
Maximum current	3 kn
Minimum mooring depth	6 ft
Maximum mooring depth	105 ft

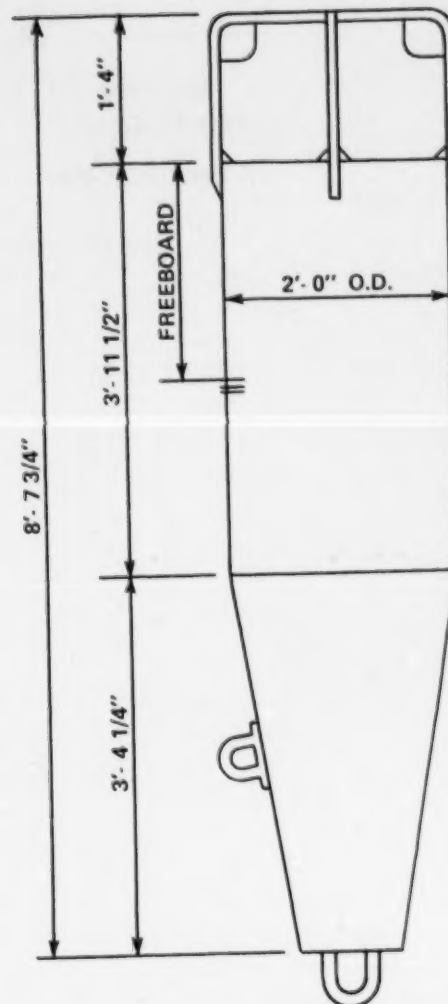


Figure 2-52. Dimensions of the 5 CR.

Data Sheet 2-D(27). 5 CR buoy.

Additional Data. Buoys with operational characteristics similar to the 1952 5 CR radar reflector type are shown in Figure

2-53. The 1942-type 5 C was formerly called a 3 CS.

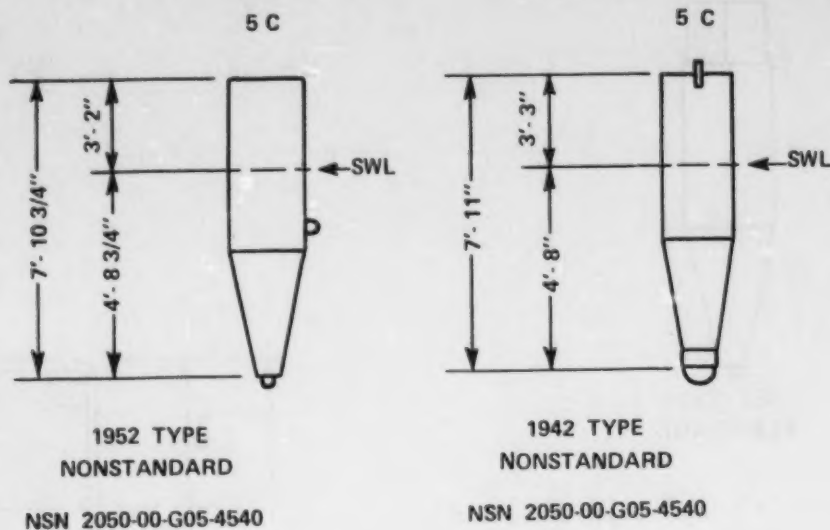


Figure 2-53. Nonstandard substitutes.



Function. The 5 NR buoy is designed and constructed for protected locations, where an unlighted NUN buoy is required.

Physical Characteristics

Buoy weight	680 lb
Buoy draft (no mooring)	4 ft-11 in.
Freeboard (no mooring)	2 ft-5 in.
Minimum freeboard	6 in.
Pounds per inch of immersion	16

Related Equipment

Mooring chain size	7/16 or 1/2 in.
Sinker size	2,000 lb

Operational Characteristics

Nominal visual range of daymark	1 nmi
Radar range	1.25 nmi
Maximum current	3 kn
Minimum mooring depth	6 ft
Maximum mooring depth	100 ft

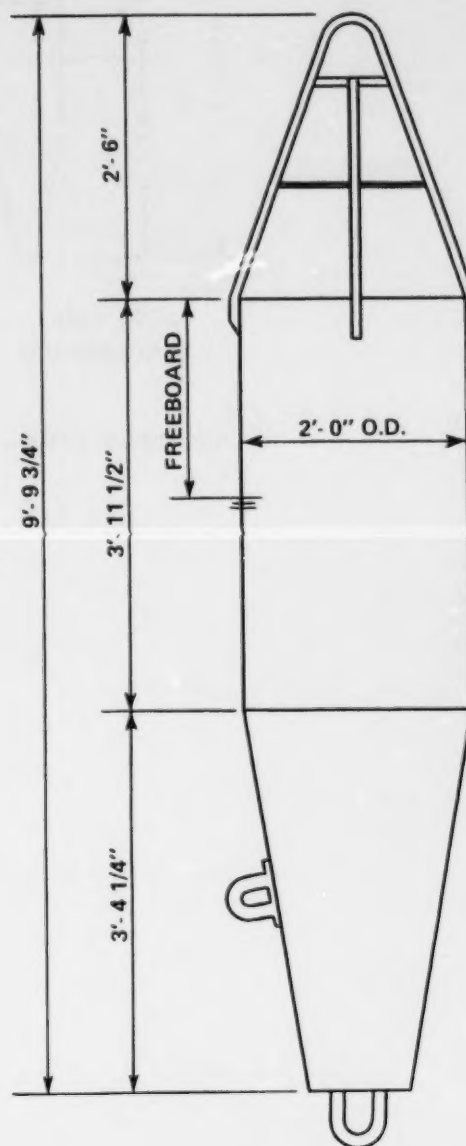


Figure 2-54. Dimensions of the 5 NR.

Data Sheet 2-D(28). 5 NR buoy

Additional Data. Buoys with operational characteristics similar to the 1952 5 NR radar reflector type are shown in Figure

2-55. The 1942-type 5 N was formerly called a 3 NS.

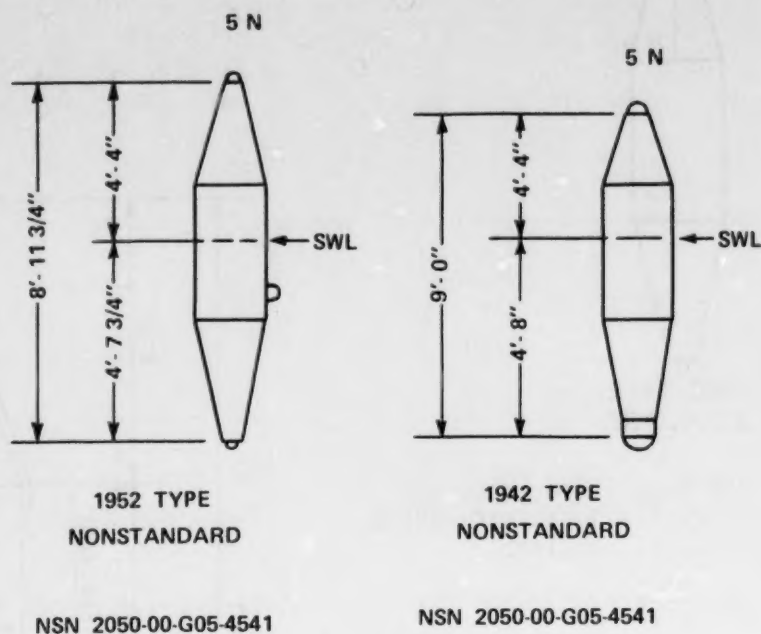
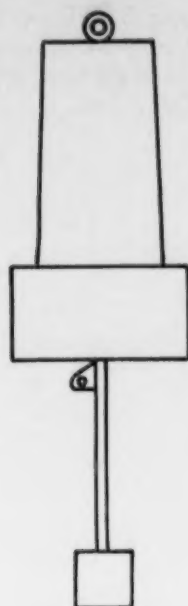


Figure 2-55. Nonstandard substitutes.

1972 TYPE
STANDARD

Function. The 5 CPR buoy is designed and constructed for protected locations, where an unlighted CAN buoy is required. This buoy is foam filled. It should not be used in ice.

Physical Characteristics

Buoy weight	150 lb
Buoy draft (no mooring)	4 ft-0 in.
Freeboard (no mooring)	8 in.
Minimum freeboard	3 in.
Pounds per inch of immersion	22

Related Equipment

Mooring chain size	7/16 or $\frac{1}{2}$ in.
Sinker size	500 lb

Operational Characteristics

Nominal visual range of daymark	1 nmi
Radar range	1 nmi
Maximum current	3 kn
Minimum mooring depth	5 ft
Maximum mooring depth	35 ft

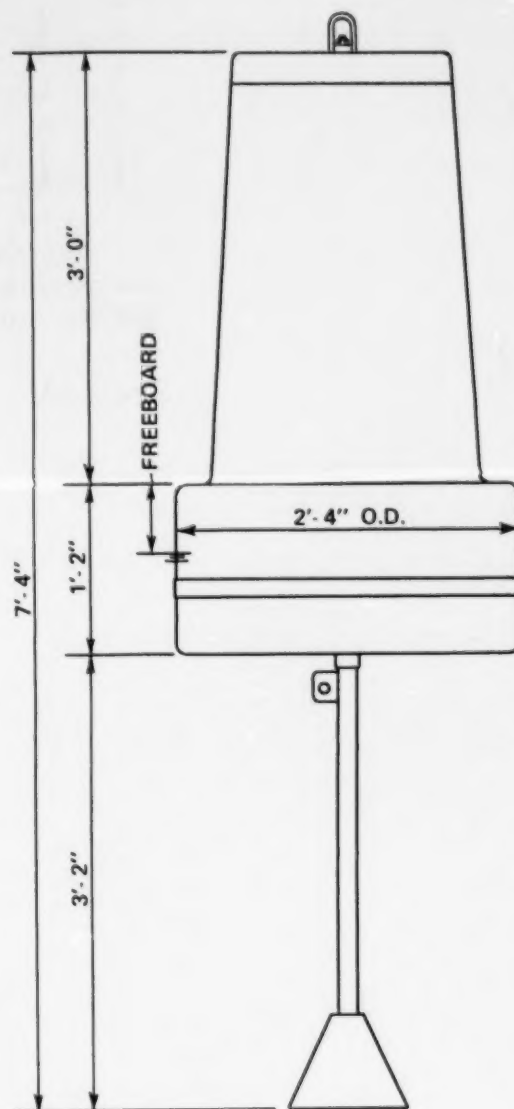
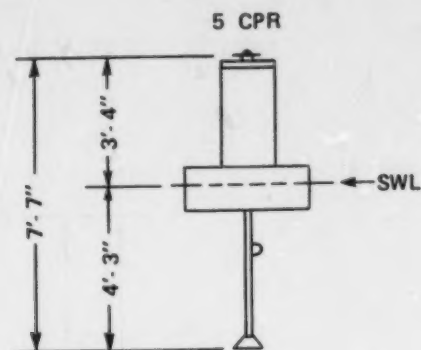


Figure 2-56. Dimensions of the 5 CPR.

Data Sheet 2-D(29). 5 CPR buoy.

Additional Data. The 1972-type 5 CPR buoy shown at the top of this data sheet is manufactured by Automatic Power, Inc., and is presently a qualified product.

Another 1972-type 5 CPR is shown in Figure 2-57. It has the same operational characteristics and is manufactured by Rolyan Manufacturing Co., Inc.

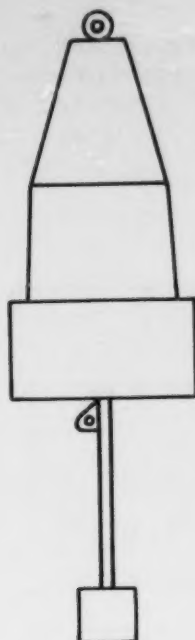


1972 TYPE
STANDARD

NSN 2050-00-G05-4955 (BLACK)

NSN 2050-00-G05-7461 (WHITE)

Figure 2-57. Standard substitute.

1972 TYPE
STANDARD

Function. The 5 NPR buoy is designed and constructed for protected locations, where an unlighted NUN buoy is required. This buoy is foam filled. It should not be used in ice.

Physical Characteristics

Buoy weight	150 lb
Buoy draft (no mooring)	4 ft-0 in.
Freeboard (no mooring)	8 in.
Minimum freeboard	3 in.
Pounds per inch of immersion	22

Related Equipment

Mooring chain size	7/16 or 1/2 in.
Sinker size	500 lb

Operational Characteristics

Nominal visual range of daymark	1 nmi
Radar range	1 nmi
Maximum current	3 kn
Minimum mooring depth	5 ft
Maximum mooring depth	35 ft

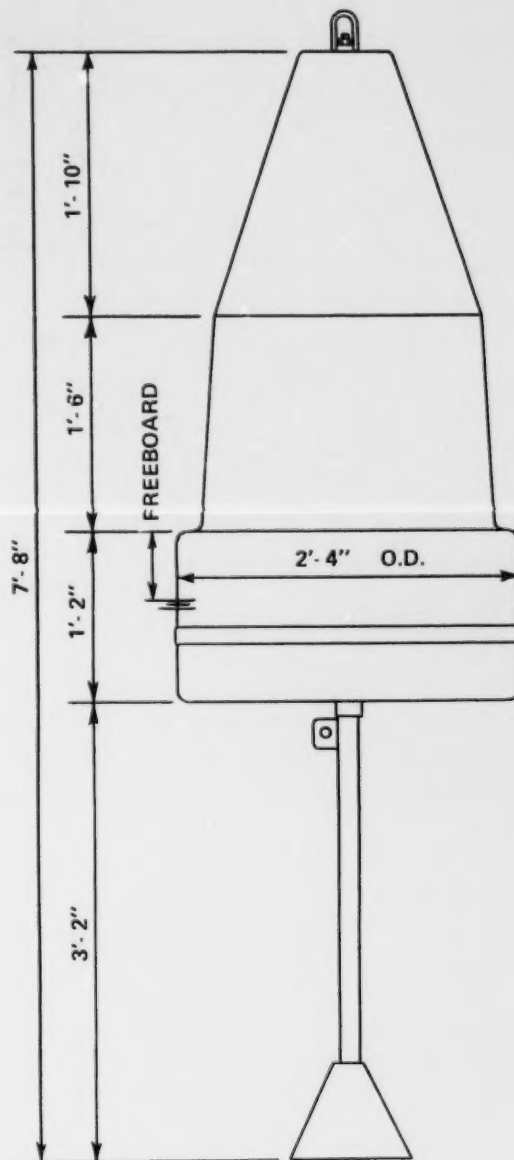


Figure 2-58. Dimensions of the 5 NPR.

Data Sheet 2-D(30). 5 NPR buoy.

Additional Data. The 1972-type 5 NPR buoy shown at the top of this data sheet is manufactured by Automatic Power, Inc., and is presently a qualified product.

Another 1972-type 5 NPR is shown in Figure 2-59. It has the same operational characteristics and is manufactured by Rolyan Manufacturing Co., Inc.

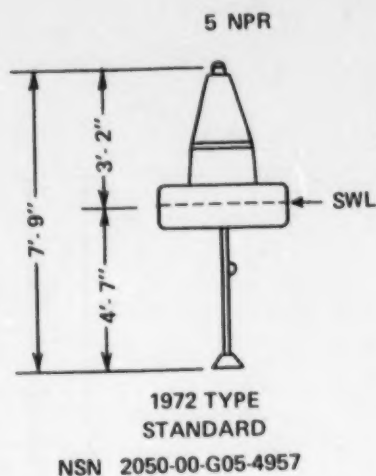


Figure 2-59. Standard substitute.



**1952 TYPE
STANDARD**

Function. The 6 CR buoy is designed and constructed for river environments and protected locations, where an unlighted CAN buoy is required. This buoy is foam filled.

Physical Characteristics

Buoy weight	160 lb
Buoy draft (no mooring)	3 ft-10 in.
Freeboard (no mooring)	2 ft-6 in.
Minimum freeboard	6 in.
Pounds per inch of immersion	9

Related Equipment

Mooring chain size	7/16 or 1/2 in.
Mooring wire rope size	3/8 in.
Sinker size	500 lb

Operational Characteristics

Nominal visual range of daymark	1 nmi
Radar range	1 nmi
Maximum current	2.5 kn
Minimum mooring depth	6 ft
Maximum mooring depth	60 ft

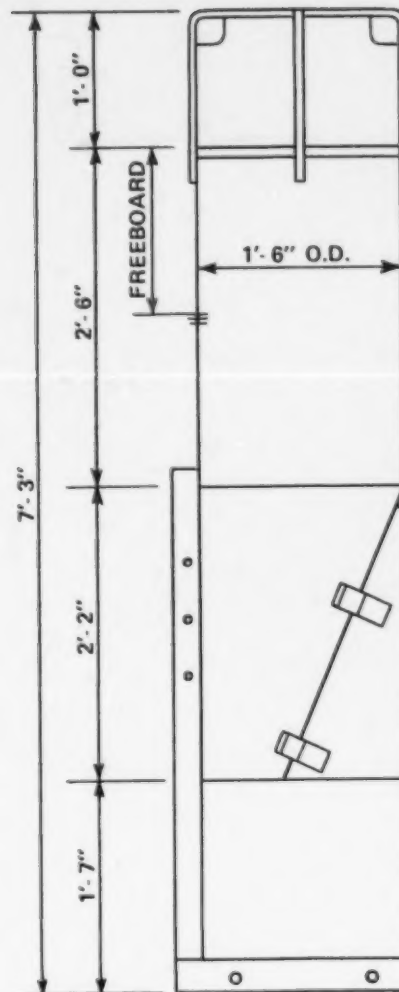


Figure 2-60. Dimensions of the 6 CR.

Data Sheet 2-D(31). 6 CR buoy.

Additional Data. Buoys with operational characteristics similar to the 1952-type

6 CR are shown in Figure 2-61.

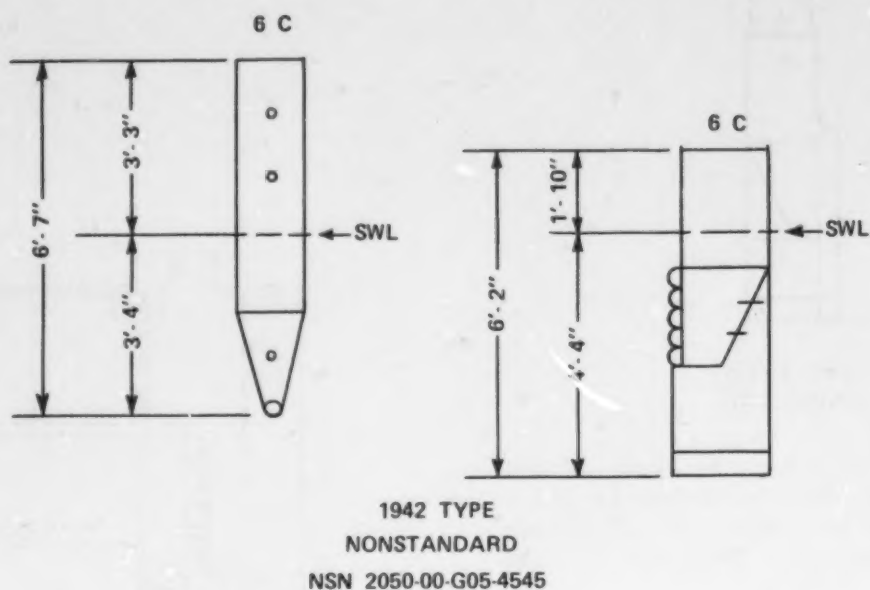
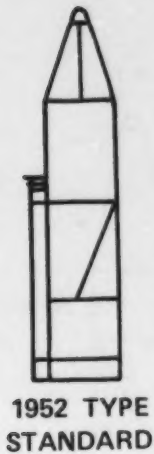


Figure 2-61. Nonstandard substitutes.



Function. The 6 NR buoy is designed and constructed for river environments and protected locations, where an unlighted NUN buoy is required. This buoy is foam filled.

Physical Characteristics

Buoy weight	165 lb
Buoy draft (no mooring)	4 ft-0 in.
Freeboard (no mooring)	2 ft-8 in.
Minimum freeboard	6 in.
Pounds per inch of immersion	9

Related Equipment

Mooring chain size	7/16 or 1/2 in.
Mooring wire rope size	3/8 in.
Sinker size	500 lb

Operational Characteristics

Nominal visual range of daymark	1 nmi
Radar range	1 nmi
Maximum current	2.5 kn
Minimum mooring depth	6 ft
Maximum mooring depth	64 ft

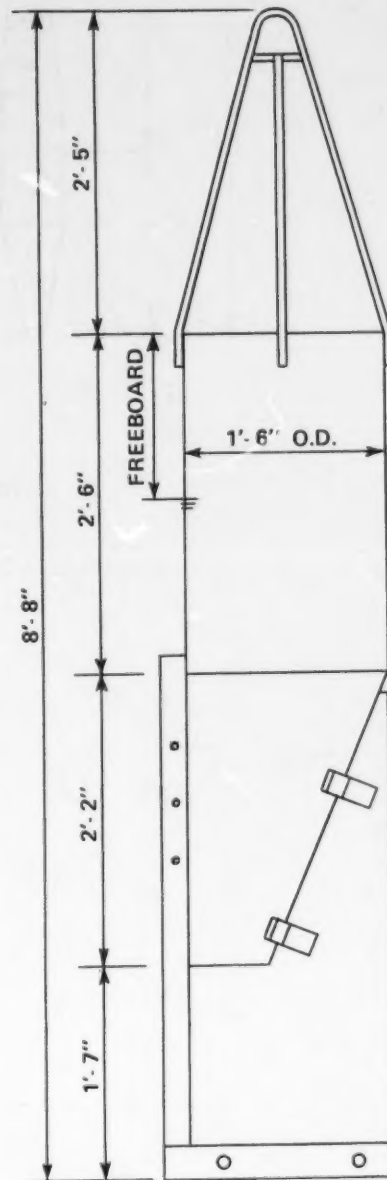


Figure 2-62. Dimensions of the 6 NR.

Data Sheet 2-D(32). 6 NR buoy.

Additional Data. Buoys with operational characteristics similar to the 1952-type

6 NR are shown in Figure 2-63.

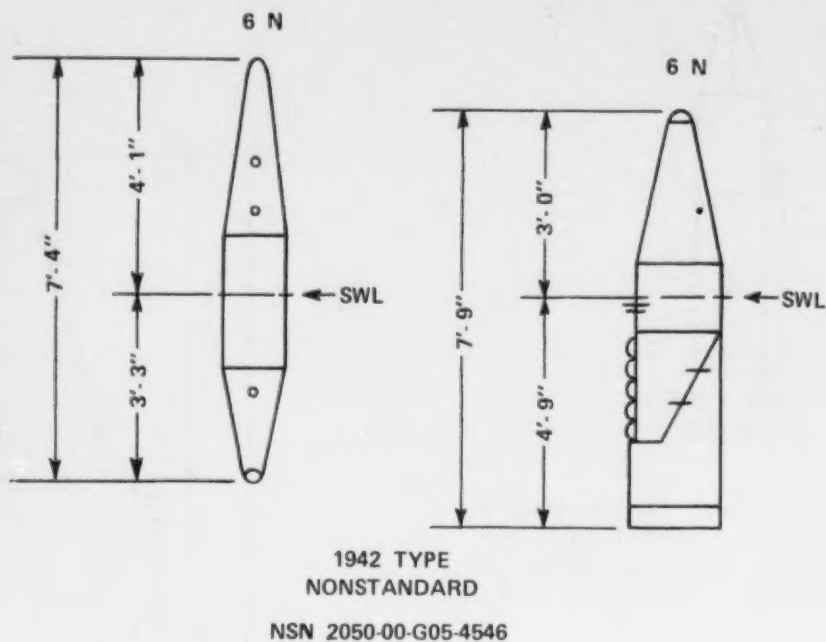


Figure 2-63. Nonstandard substitutes.



**1952 TYPE
STANDARD**

Function. The 6 CT buoy is designed and constructed for river environments, where a radar reflector is not required. This buoy is foam filled.

Physical Characteristics

Buoy weight	165 lb
Buoy draft (no mooring)	4 ft-0 in.
Freeboard (no mooring)	2 ft-9 in.
Minimum freeboard	1 ft-6 in.
Pounds per inch of immersion	9

Related Equipment

Mooring chain size	7/16 or 1/2 in.
Mooring wire rope size	3/8 in.
Sinker size	500 lb

Operational Characteristics

Nominal visual range of daymark	1 nmi
Radar range	.5 nmi
Maximum current	2.5 kn
Minimum mooring depth	6 ft
Maximum mooring depth	37 ft

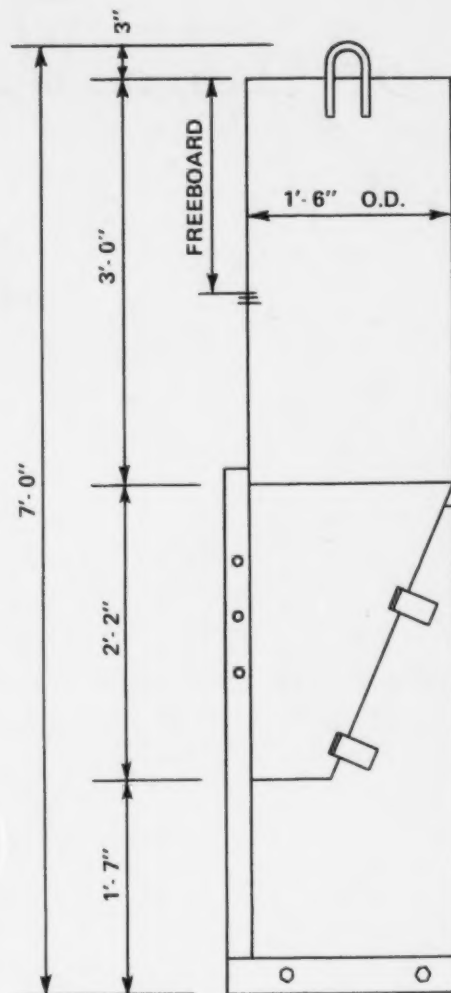
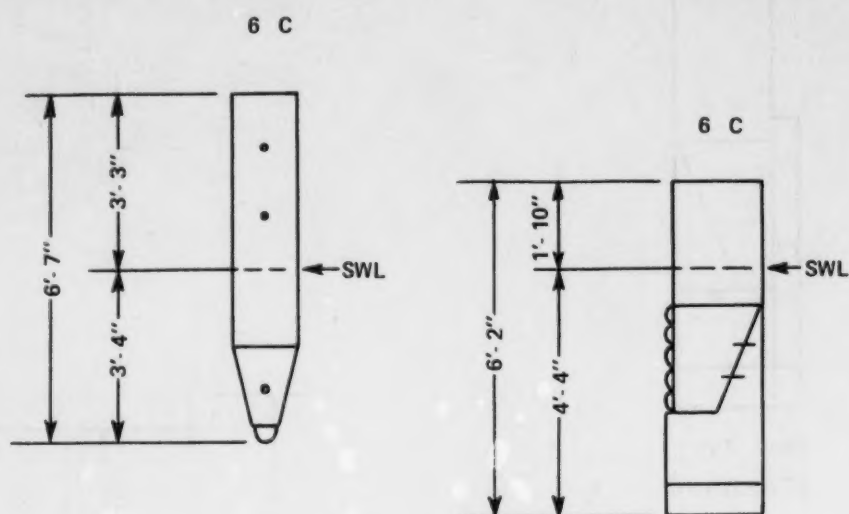


Figure 2-64. Dimensions of the 6 CT.

Data Sheet 2-D(33). 6 CT buoy.

Additional Data. Buoys with operational characteristics similar to the 1952-type

6 CT are shown in Figure 2-65.



1942 TYPE
NONSTANDARD

NSN 2050-00-G05-4545

Figure 2-65. Nonstandard substitutes.



1952 TYPE STANDARD

Function. The 6 NT buoy is designed and constructed for river environments, where a radar reflector is not required. This buoy is foam filled.

Physical Characteristics

Buoy weight	170 lb
Buoy draft (no mooring)	4 ft-0 in.
Freeboard (no mooring)	4 ft-2 in.
Minimum freeboard	2 ft-6 in.
Pounds per inch of immersion	6

Related Equipment

Mooring chain size	7/16 or 1/2 in.
Mooring wire rope size	3/8 in.
Sinker size	500 lb

Operational Characteristics

Nominal visual range of daymark	1 nmi
Radar range	.5 nmi
Maximum current	2.5 kn
Minimum mooring depth	6 ft
Maximum mooring depth	49 ft

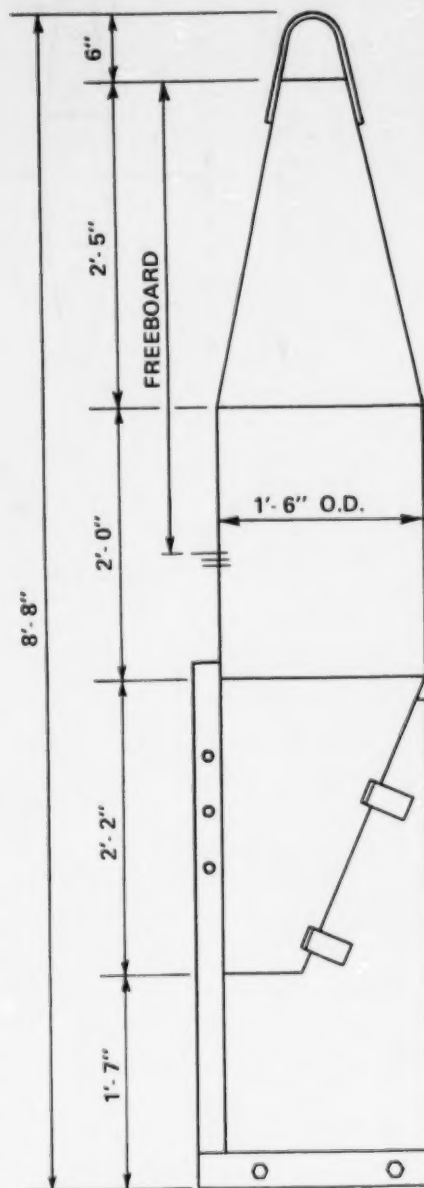


Figure 2-66. Dimensions of the 6 NT.

Data Sheet 2-D(34). 6 NT buoy.

Additional Data. Buoys with operational characteristics similar to the 1952-type

6 NT are shown in Figure 2-67.

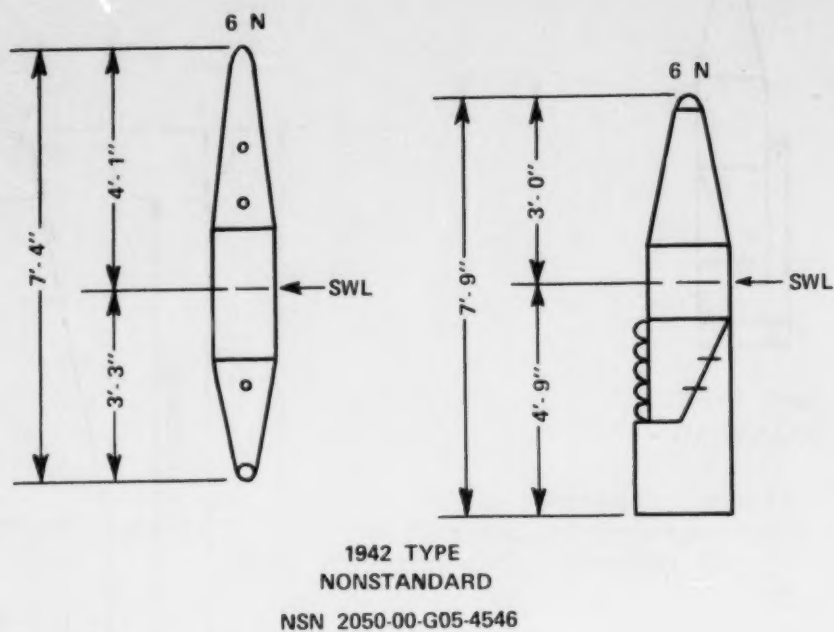
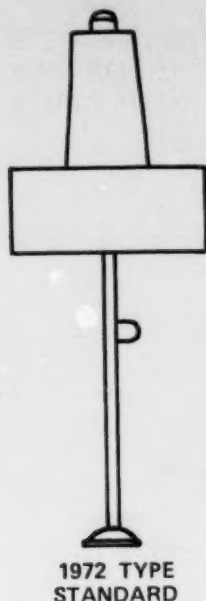


Figure 2-67. Nonstandard substitutes.

6 CPR



1972 TYPE
STANDARD

Function. The 6 CPR buoy is designed and constructed for protected locations, where an unlighted CAN buoy is required. This buoy is foam filled. It should not be used in ice.

Physical Characteristics

Buoy weight	85 lb
Buoy draft (no mooring)	4 ft-0 in.
Freeboard (no mooring)	8½ in.
Minimum freeboard	3 in.
Pounds per inch of immersion	22

Related Equipment

Mooring chain size	7/16 or ½ in.
Sinker size	500 lb

Operational Characteristics

Nominal visual range of daymark	.5 nmi
Radar range	.75 nmi
Maximum current	3 kn
Minimum mooring depth	5 ft
Maximum mooring depth	35 ft

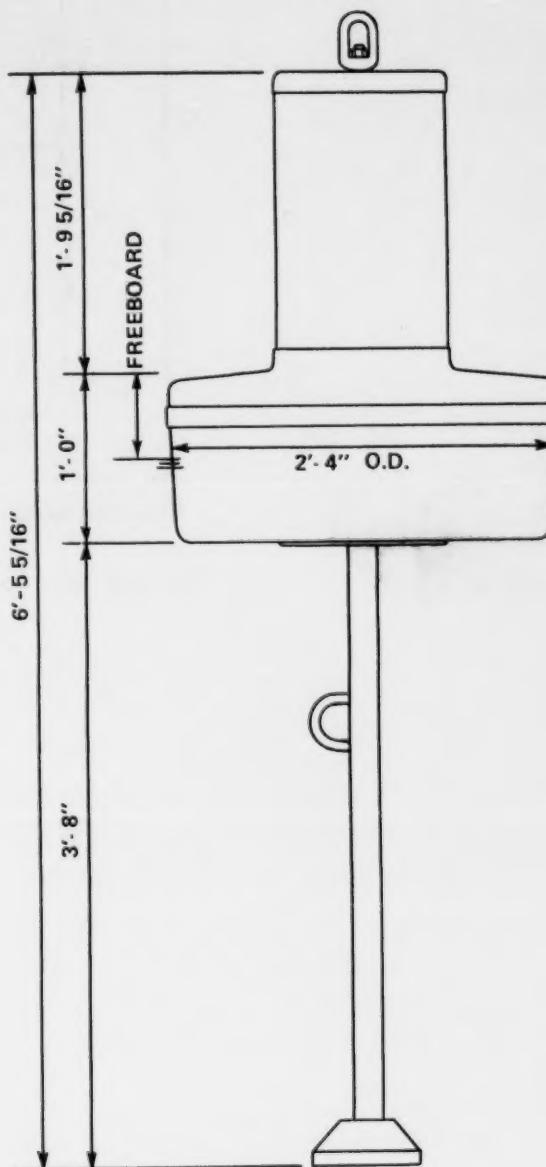
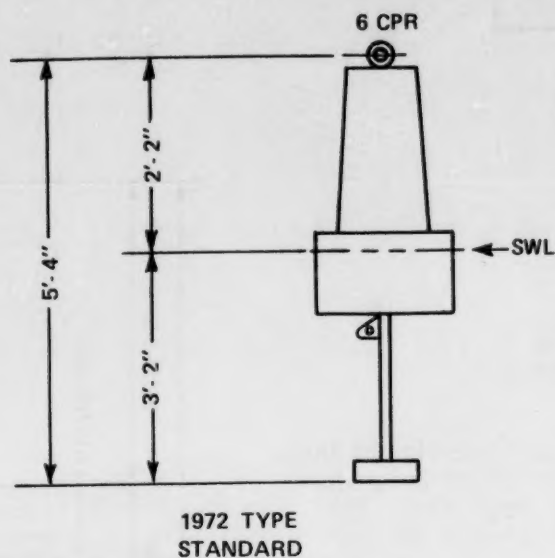


Figure 2-68. Dimensions of the 6 CPR.

Data Sheet 2-D(35). 6 CPR buoy.

Additional Data. The 1972-type 6 CPR buoy shown at the top of this data sheet is manufactured by Rolyan Manufacturing Co., Inc., and is presently a qualified prod-

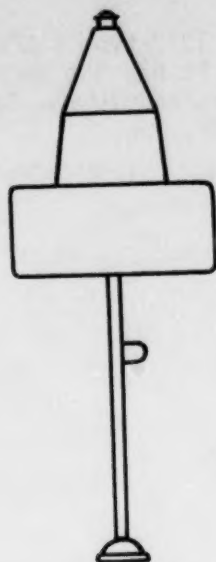
uct. Another 1972-type 6 CPR is shown in Figure 2-69. It has the same operational characteristics and is manufactured by Automatic Power, Inc.



NSN 2050-00-G05-4950 (BLACK)

NSN 2050-00-G05-7460 (WHITE)

Figure 2-69. Standard substitute.

1972 TYPE
STANDARD

Function. The 6 NPR buoy is designed and constructed for protected locations, where an unlighted NUN buoy is required. This buoy is foam filled. It should not be used in ice.

Physical Characteristics

Buoy weight	85 lb
Buoy draft (no mooring)	4 ft-0 in.
Freeboard (no mooring)	8½ in.
Minimum freeboard	3 in.
Pounds per inch of immersion	22

Related Equipment

Mooring chain size	7/16 or ½ in.
Sinker size	500 lb

Operational Characteristics

Nominal visual range of daymark	.5 nmi
Radar range	.75 nmi
Maximum current	3 kn
Minimum mooring depth	5 ft
Maximum mooring depth	35 ft

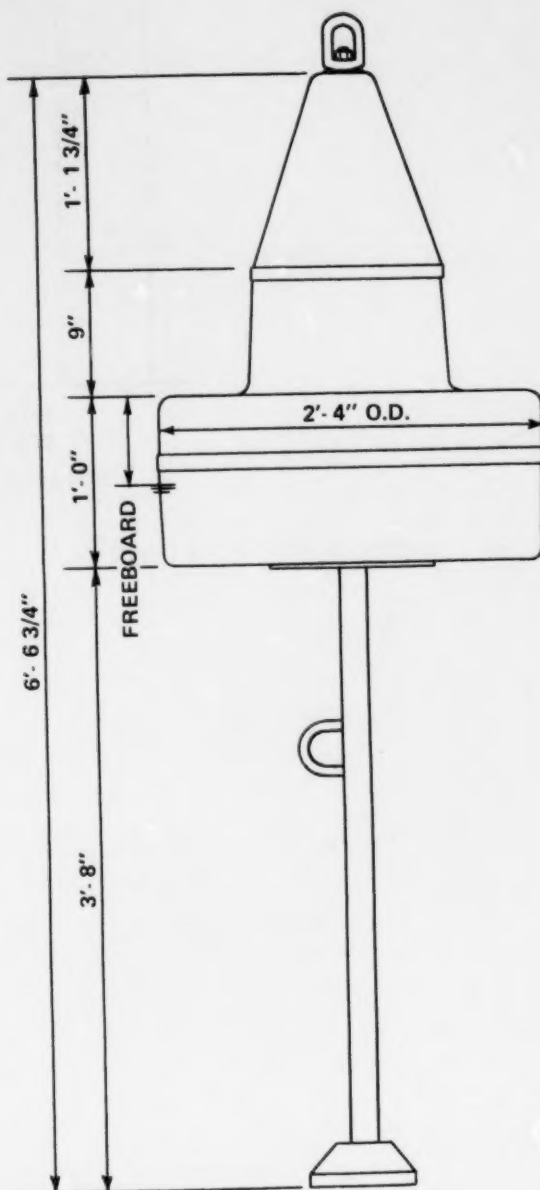


Figure 2-70. Dimensions of the 6 NPR.

Data Sheet 2-D(36). 6 NPR buoy.

Additional Data. The 1972-type 6 NPR buoy shown at the top of this data sheet is manufactured by Rolyan Manufacturing Co., Inc., and is presently a qualified prod-

uct. Another 1972-type 6 NPR is shown in Figure 2-71. It has the same operational characteristics and is manufactured by Automatic Power, Inc.

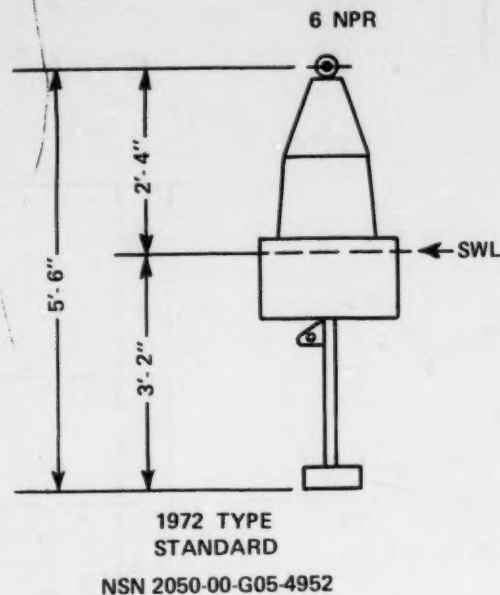
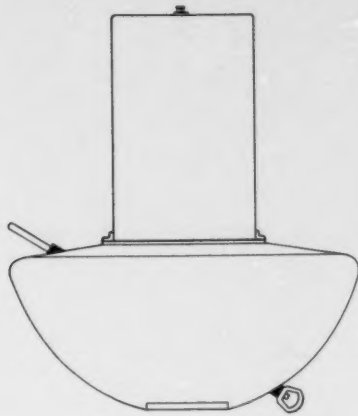


Figure 2-71. Standard substitute.

FCPR



Function. The FCPR buoy is designed and constructed for fast water locations where an unlighted CAN buoy is required. The hull portion of the buoy is foam filled.

Physical Characteristics

Buoy weight	161 lb
Buoy draft (no mooring)	3 in.
Freeboard (no mooring)	21 in.
Minimum freeboard	1 in.
Pounds per inch of immersion	29

Related Equipment

Mooring chain size	$\frac{1}{2}$ in.
Wire rope size	$\frac{1}{2}$ in.
Sinker size	500 lb or larger (depending on current)

Operational Characteristics

Nominal visual range of daymark	1 nmi
Radar range	.75 nmi
Maximum current	7 kn
Minimum mooring depth	3 ft
Maximum mooring depth	100 ft

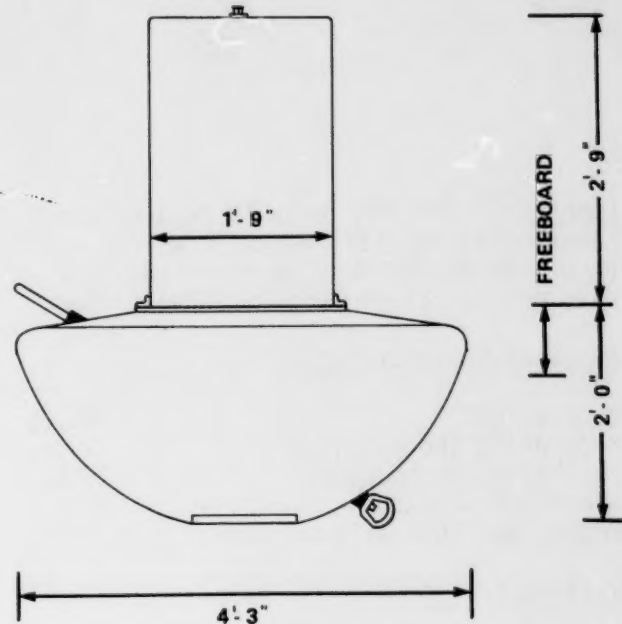
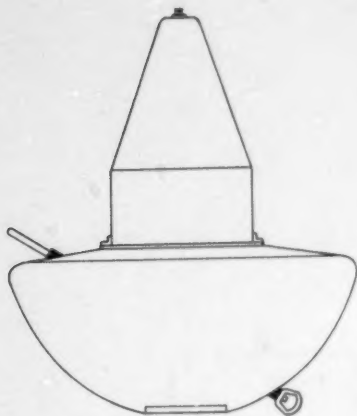


Figure 2-72. Dimensions of the FCPR.

Additional Data. Two sizes of fast water buoys were bought in quantity for evaluation. These buoys were called FCR3 and FCR4. The FCR3 buoy is the same size as the FCPR buoy. The FCR4 buoy has a hull that is 5 ft in diameter and a daymark that is somewhat larger than the FCR3 daymark.

FNPR



Function. The FNPR buoy is designed and constructed for fast water locations where an unlighted NUN buoy is required. The hull portion of the buoy is foam filled.

Physical Characteristics

Buoy weight	161 lb
Buoy draft (no mooring)	3 in.
Freeboard (no mooring)	21 in.
Minimum freeboard	1 in.
Pounds per inch of immersion	29

Related Equipment

Mooring chain size	$\frac{1}{2}$ in.
Wire rope size	$\frac{1}{2}$ in.
Sinker size	500 lb or larger (depending on current)

Operational Characteristics

Nominal visual range of daymark	1 nmi
Radar range	.75 nmi
Maximum current	7 kn
Minimum mooring depth	3 ft
Maximum mooring depth	100 ft

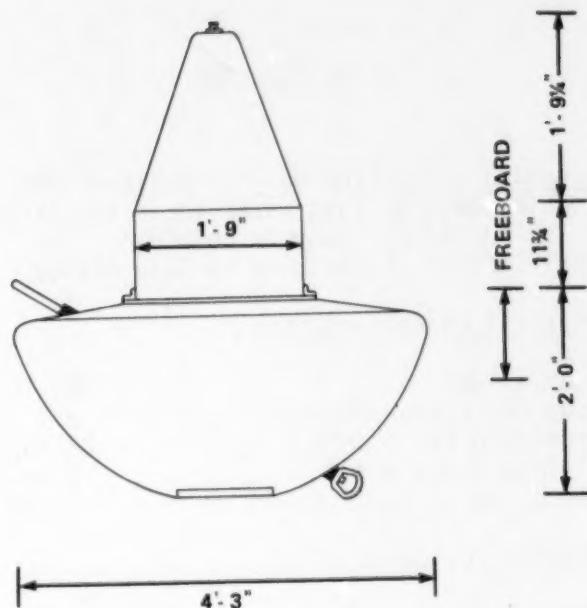


Figure 2-73. Dimensions of the FNPR.

Additional Data. Two sizes of fast water buoys were bought in quantity for evaluation. These buoys were called FNR3 and FNR4. The FNR3 buoy is the same size as the FNPR buoy except that the daymark is slightly shorter. The FNR4 buoy has a hull that is 5 ft in diameter and a daymark that is somewhat larger than the FNR3 daymark.

BUOY SERIAL NUMBERS

Function. Buoy serial numbers are used on steel buoys to identify them in the system and to establish their age and year type. On plastic buoys, the identification number gives the lot, year built, and manufacturer's code.

Additional Data

Lighted Buoys and Unlighted Sound Buoys. Each lighted or unlighted steel buoy that is built by the Coast Guard Yard is given a serial number that is welded to the buoy top. The numbers are interpreted as follows:

6-74-15

- 15th buoy of this type built in the specified year
- year built (1974)
- diameter of the buoy body in feet.

Unlighted Buoys. The unlighted first-, second-, and third-class steel buoys constructed by the Coast Guard Yard also have a serial number welded to the buoy top. The numbers are interpreted as follows:

2-C-74-09

- ninth buoy of this type built in the specified year
- year built (1974)
- CAN buoy (N for NUN)
- class of buoy (second).

The Second District does not put serial numbers on its fourth-, fifth-, and sixth-class unlighted steel buoys.

Plastic Buoys. The fifth- and sixth-class plastic buoys will have an identification number molded or engraved at the top or bottom of the daymark. Also molded or engraved at this location will be "U.S. COAST GUARD." The numbers on these buoys are interpreted as follows:

7-75-R0

- two-letter code for manufacturer (Rolyan)
- year built (1975)
- month built (July).

VENT LINES

Function. The air-depolarized primary batteries used in lighted buoys require a continuous supply of air, which is provided through stainless steel vent lines, shown in Figure 2-74. On single-pocket buoys, two vent lines are used on the one pocket. On buoys with two pockets, there is one vent line per pocket, with a crossover tube between the pockets. The crossover tube operates on the theory that air that feeds one pocket will circulate into

the second pocket and exit through the second vent line.

Dimensions. The length of the vent line varies with each buoy. Three-quarter-inch schedule 40 pipe is used for the vent line and 2-in. schedule 40 pipe is used for the crossover tube.

Related Equipment. The vent line is terminated with a PVC reducer and a vent valve.

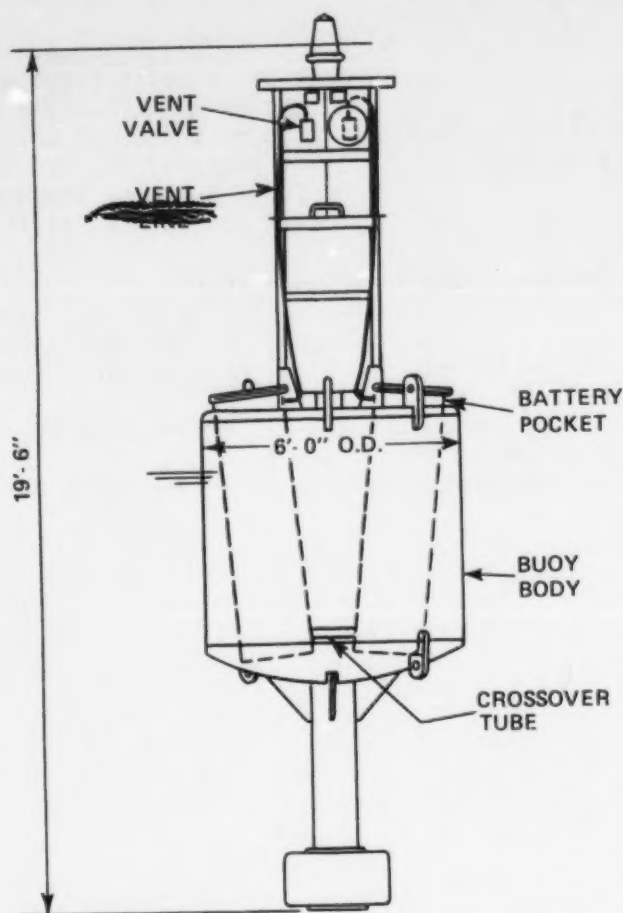


Figure 2-74. Vent line and crossover tube placement on a two-pocket buoy.

Data Sheet 2-D(40). Vent lines.

VENT VALVES

Function. Vent valves are designed to seal the vent lines on lighted buoys if the buoy heels over beyond 30 degrees, is capsized, or submerges in an upright position.

Features

- Yellow polypropylene upper ball
- Black lead-filled lower ball
- PVC plastic valve body

Related Equipment. The vent valve, used in conjunction with a PVC reducer, is attached to the end of the 3/4-in. vent line.

Additional Data

Complete vent valve	NSN 4820-00-076-6748
PVC reducer	NSN 4730-00-600-2331

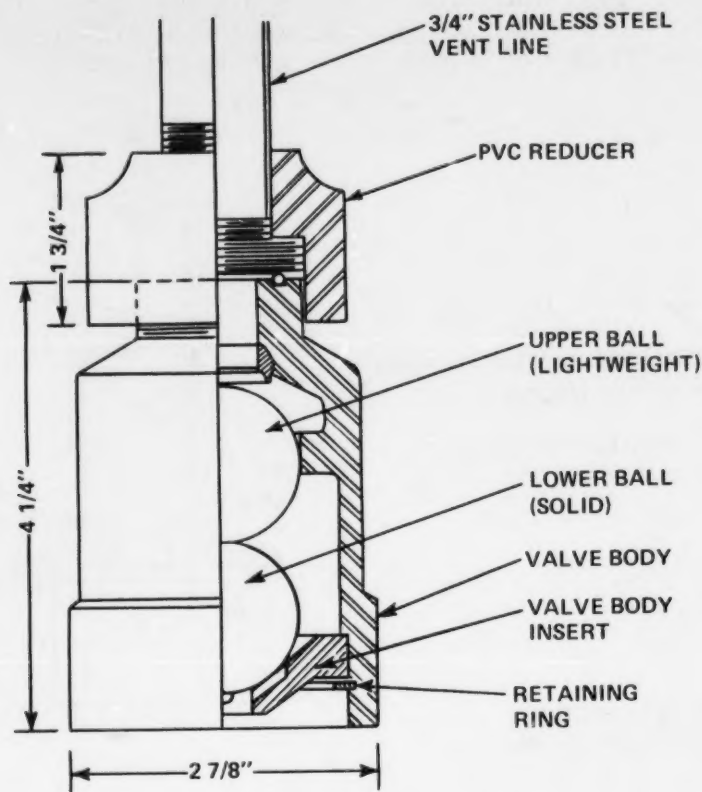


Figure 2-75. Vent valve dimensions.

Data Sheet 2-D(41). Vent valves.

WIRING

Function. The external wiring of the buoy is used to carry electrical current from the batteries to the lantern.

Features

- Two conductor
- Standard black and white
- Number 12
- Type SO

Dimensions. The length of cable varies according to the buoy type, number of power units, and wiring method. The length of cable required to run from a

1000-Ah power unit to the lantern is given below:

<u>Buoy</u>	<u>Length of Cable (ft)</u>
3½X8	10
5X11	10
6X20	19
7X17	19
8X26	25
9X32	30

Additional Data. Figures 2-76 through 2-81 show wiring methods for various buoy configurations.

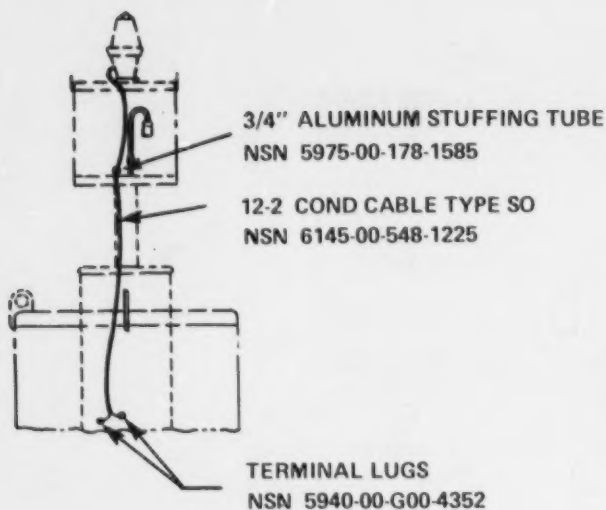


Figure 2-76. Wiring diagram for single-pocket buoy.

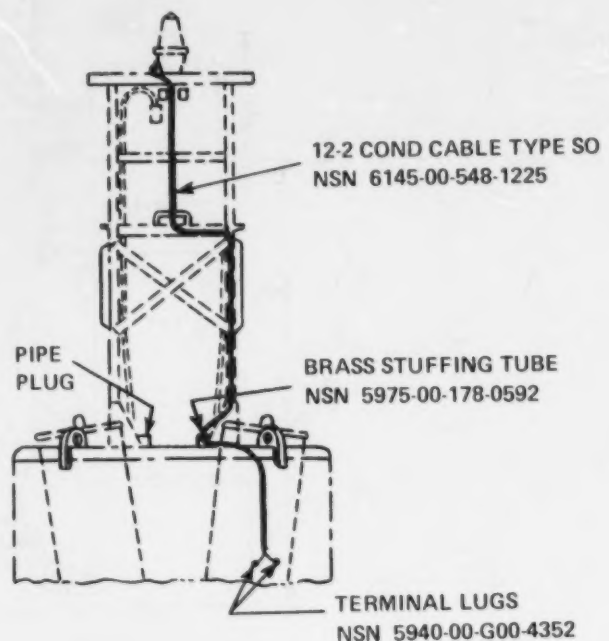


Figure 2-77. Wiring diagram for two-pocket buoy with one power unit.

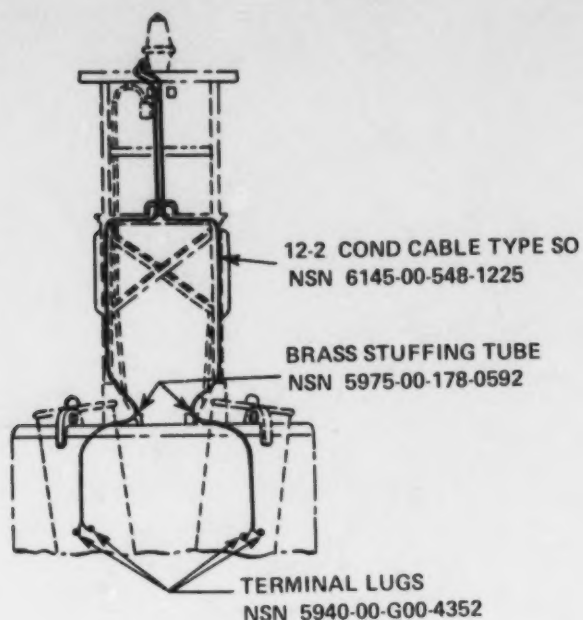


Figure 2-78. Wiring diagram for two-pocket buoy with two power units (direct wiring).

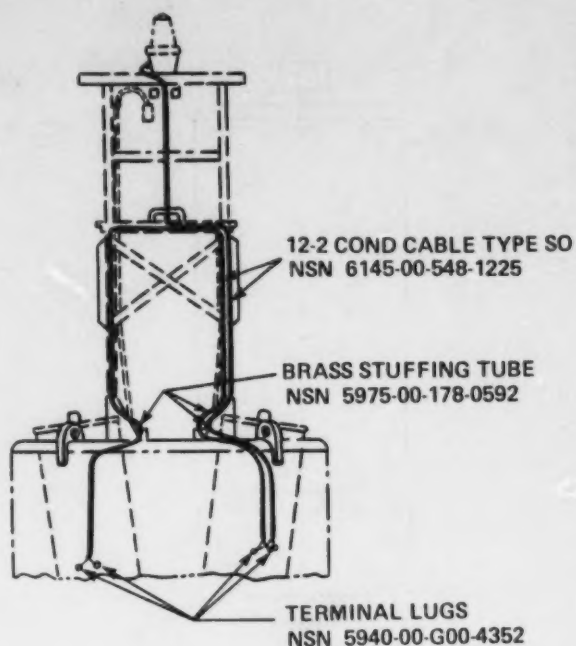


Figure 2-79. Wiring diagram for two-pocket buoy with two power units (crossover wiring).

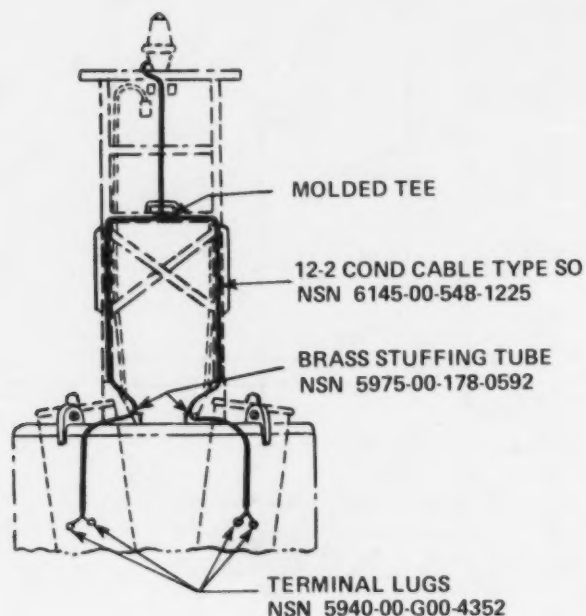


Figure 2-80. Wiring diagram for two-pocket buoy with two power units and a molded-tee junction.

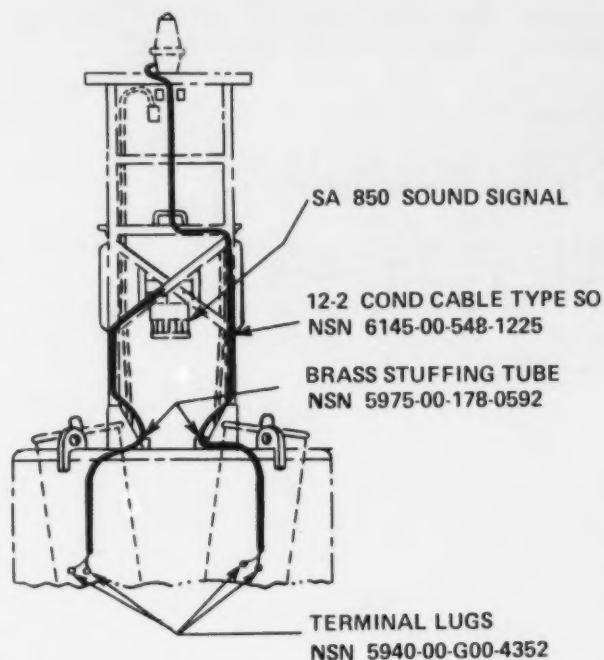
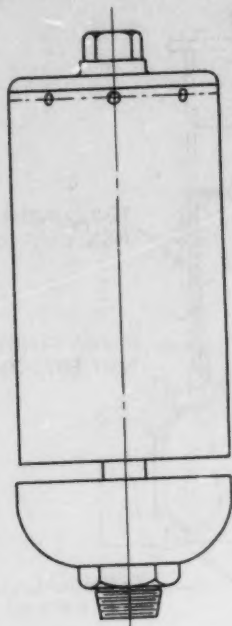


Figure 2-81. Wiring diagram for two-pocket buoy with electronic sound signal.

Data Sheet 2-D(42). (cont'd)

WHISTLE



Function. The whistle uses the up-and-down movement of a buoy in a seaway to generate a sound signal. The air in the whistle tube is compressed on the downward movement of the buoy and allowed to escape through an aperture in the bell casting, thereby blowing the whistle.

Features

- Brass casting whistle body
- 12-gage bronze whistle bell

Related Equipment. The whistle is always used in conjunction with the four-ball whistle valve. This combination is used on 9X38 LWR, 9X32 LWR, 8X26 LWR, and 8X26 WR buoys.

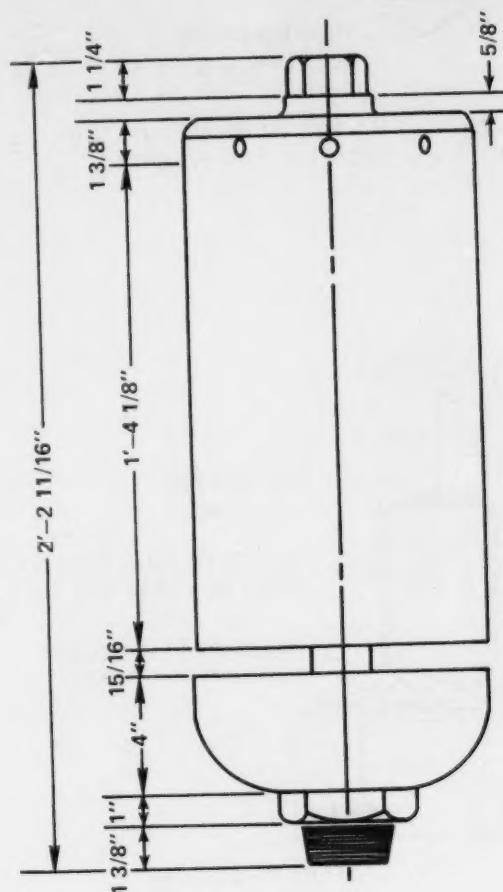
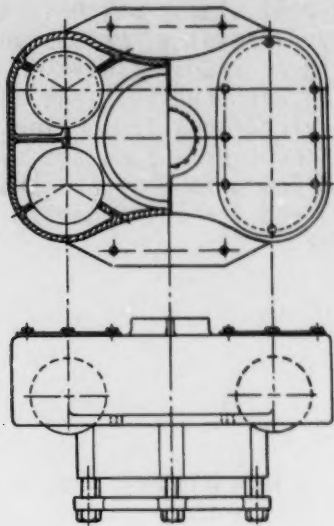


Figure 2-82. Dimensions of the whistle
(see Drawing No. BU-47-08 for detail).

Data Sheet 2-D(43). Whistle.

FOUR-BALL WHISTLE VALVE



Function. On the downward movement of a whistle buoy, the compressed air causes the balls to seal the air ports in the valve, thus forcing the air flow up into the whistle. On the upward movement, the partial vacuum created in the whistle tube causes the balls to lift and air can be drawn into the tube through the air ports. After completion of the upward movement, the ball reseals the ports and the cycle is repeated.

Features

- Brass casting valve body
- Cork or rubber balls weighing not more $\frac{1}{2}$ oz

Related Equipment. The four-ball whistle valve is always used with a whistle on 9X38 LWR, 9X32 LWR, 8X26 LWR, and 8X26 WR buoys.

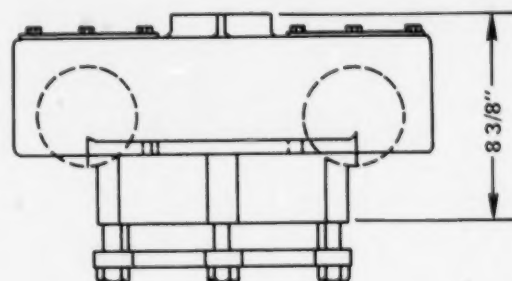
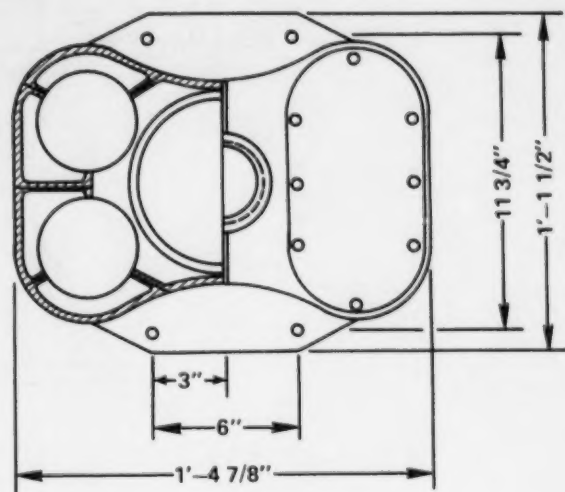


Figure 2-83. Dimensions of the four-ball whistle valve (Drawing No. BU-47-09).

Data Sheet 2-D(44). Four-ball whistle valve.

BELLS

Function. Bells made of a copper-silicon alloy are used to provide wave-actuated sound signals on 9-, 8-, and 6-ft lighted buoys and on 9-ft unlighted buoys.

Related Equipment. The 85-lb bell is used on the 6X20 LBR; the 225-lb bell, on the 8X26 LBR and the 9X20 BR; and the 1000-lb bell, on the 9X32 LBR. Each bell

requires a bell stand, which is attached to the buoy. A typical bell stand is shown in Figure 2-84. Isolation pads must be placed between the bell and bell stand to prevent vibrations from being transmitted to the tower. Pads are available under Coast Guard Yard stock number 5330-00-LG4-0003 and are cut from 1/8 in. thick rubber.

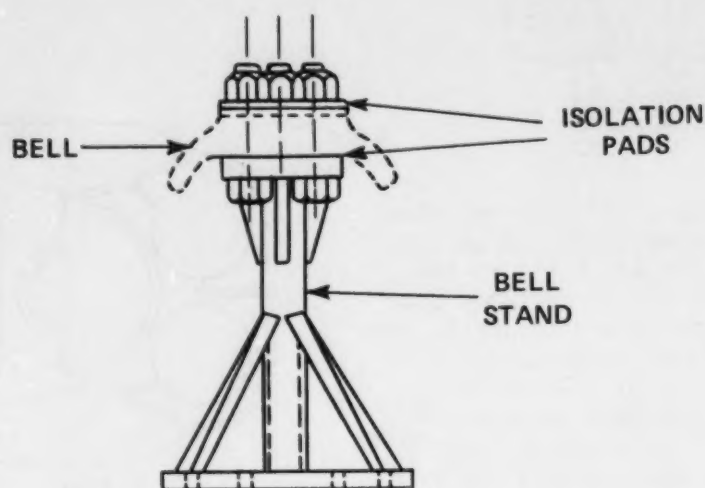


Figure 2-84. Bell stand.

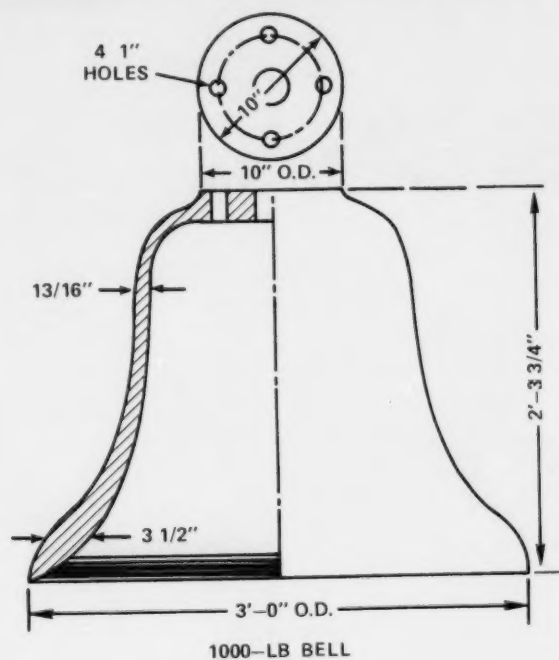
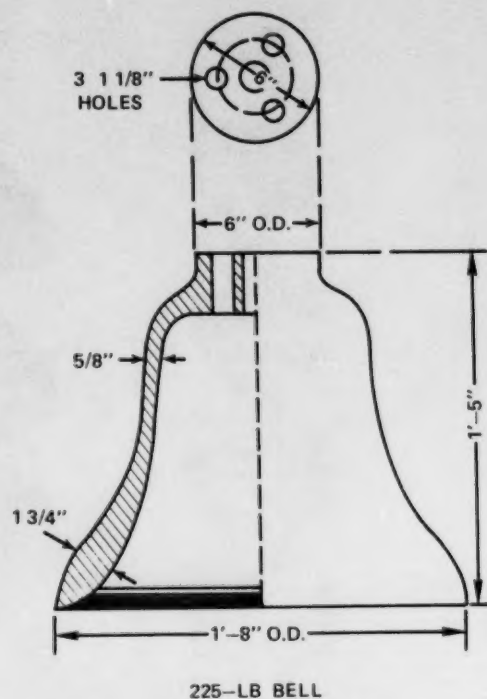
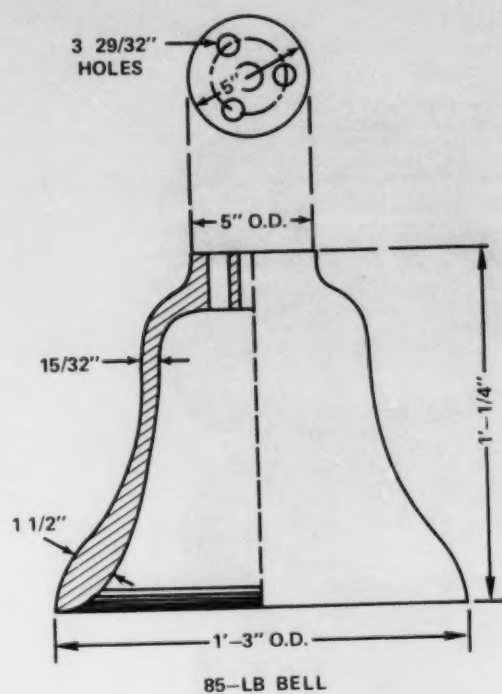
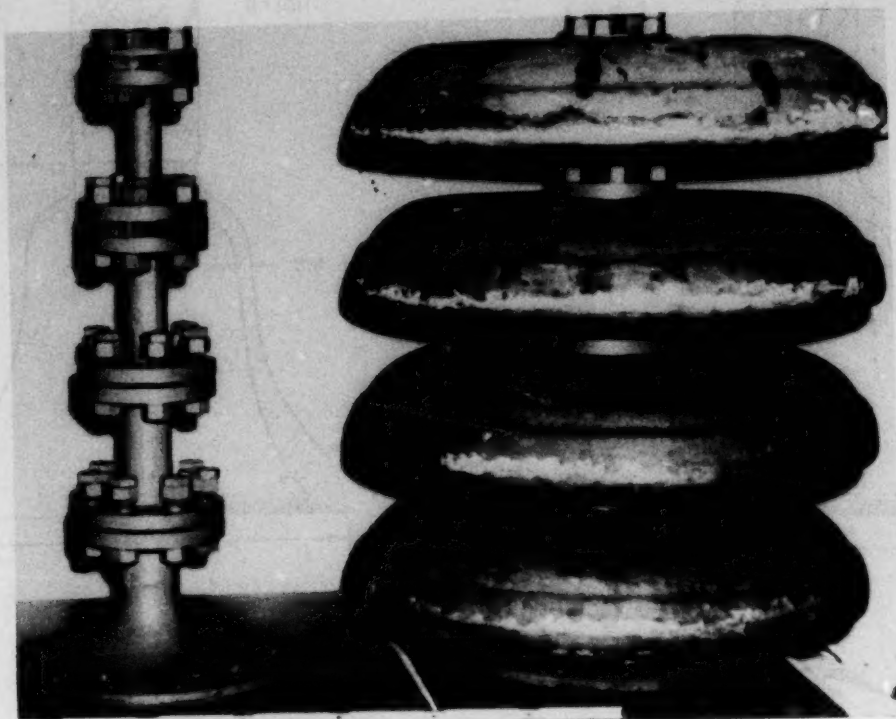


Figure 2-85. Dimensions of buoy bells (Drawing No. BU-46-16).

Data Sheet 2-D(45). (cont'd).

36-IN. GONG AND STAND



Function. The 36-in. gong and stand are used to provide wave-actuated sound signals on 9-ft lighted buoys (9X32 LGR).

Features

- Gongs of copper-silicon alloy
- Four-gong unit

Data Sheet 2-D(46). 36-in. gong and stand.

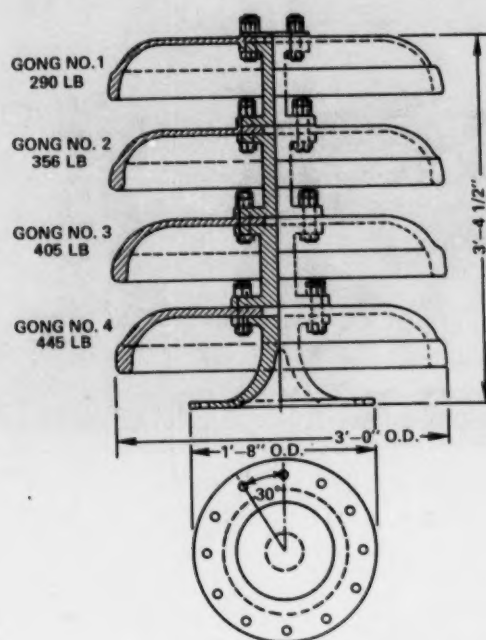
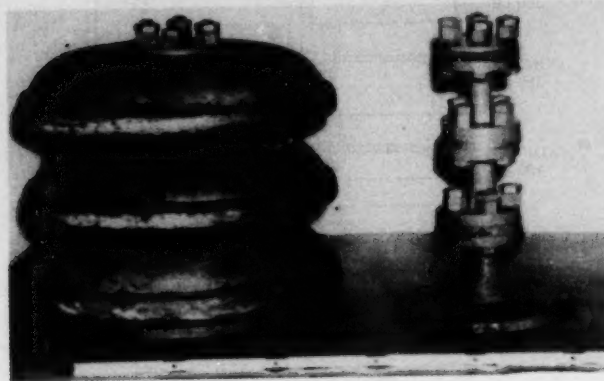


Figure 2-86. Dimensions of the 36-in. gong and stand (Drawing No. BU-47-04).

Data Sheet 2-D(46). (cont'd).

20-IN. GONG AND STAND



Function. The 20-in. gong and stand are used to provide wave-actuated sound signals on 8-ft lighted (8X26 LGR) and 9-ft unlighted (9X20 GR) buoys.

Features

- Gongs of copper-silicon alloy
- Three-gong unit

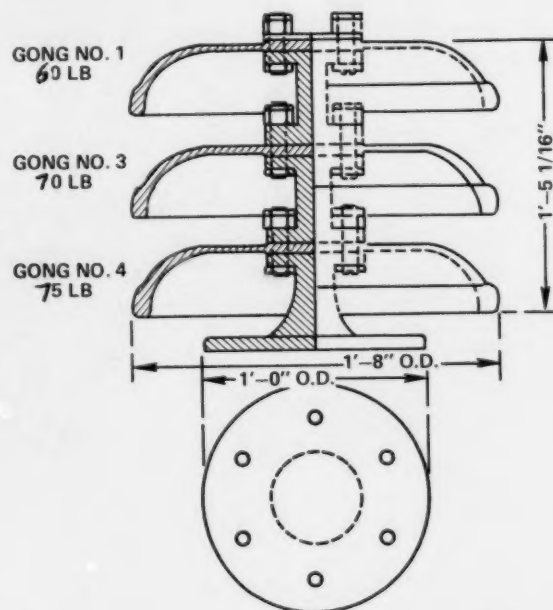


Figure 2-87. Dimensions of the 20-in. gong and stand (Drawing No. BU-47-03).

Data Sheet 2-D(47). 20-in. gong and stand.

TAPPERS

Function. Tappers sound wave-actuated sound signals by striking either the bell or gong as they swing on the buoy.

Features.

- Metal hinge
- Adjustable ball

Additional Data. The 1942-type tapper (Figure 2-88) consists of a U-shaped metal hinge that hangs from a separate tower within the light tower of the buoy. The

1952-type tapper (Figure 2-88) uses a neoprene rubber hinge. The 1962-type tapper (Figure 2-88), which uses a stainless steel pin hinge, is similar to the newer standard adjustable tapper, shown in Figure 2-89.

Both the 1952- and 1962-type tappers will continue to be issued from stock until supplies are depleted; 1942-type tappers are no longer stocked and should be fabricated locally if a demand arises.

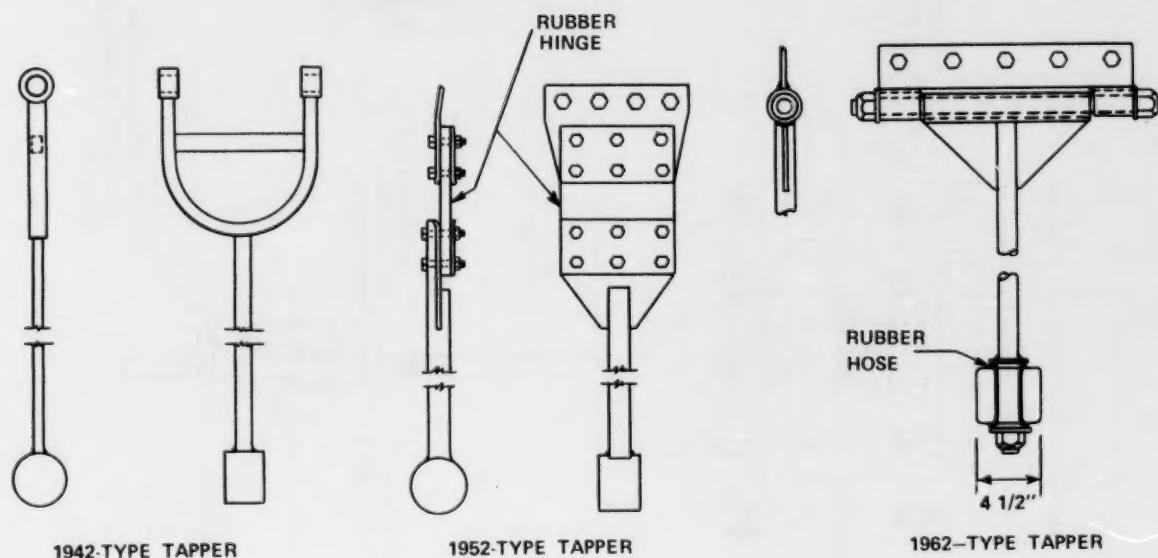
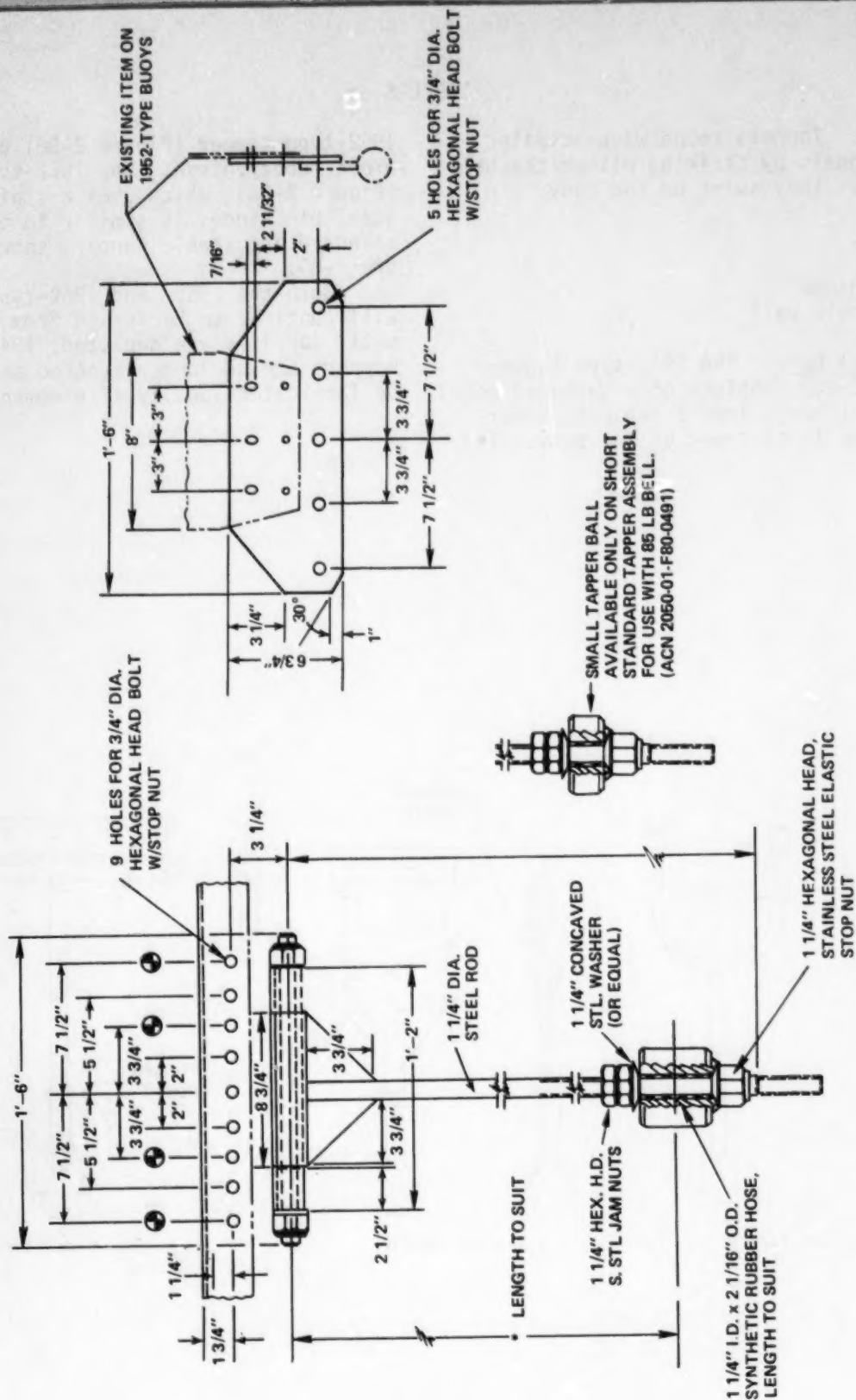


Figure 2-88. 1942-, 1952-, and 1962-type tappers.

Data Sheet 2-D(48). Tappers.



Data Sheet 2-D(48). (cont'd).

Figure 2-89. Standard buoy tappers and adapter plate (Drawing No. 120382).

V-BAND POCKET CLOSURES

Function. A V-band is a circular, ring-type, stainless steel clamp designed to fit around the pocket cover and flange so that the gasket between is compressed when the V-band is tightened--thus sealing the battery pocket.

Related Equipment. V-band pocket closures use one cork circular gasket that is supplied in two sizes, available under NSN 5330-00-776-7291 for 24-in. diameter

pockets and NSN 5330-00-776-7290 for 22-in. diameter pockets.

Additional Data. V-bands are supplied in two sizes and are available under NSN 2050-00-861-6353 for 24-in. pockets and NSN 2050-00-861-6300 for 22-in. pockets. The V-band flange shown in Figure 2-91 was adopted in 1965-- prior to this date, the flange design was as shown in Figure 2-92.

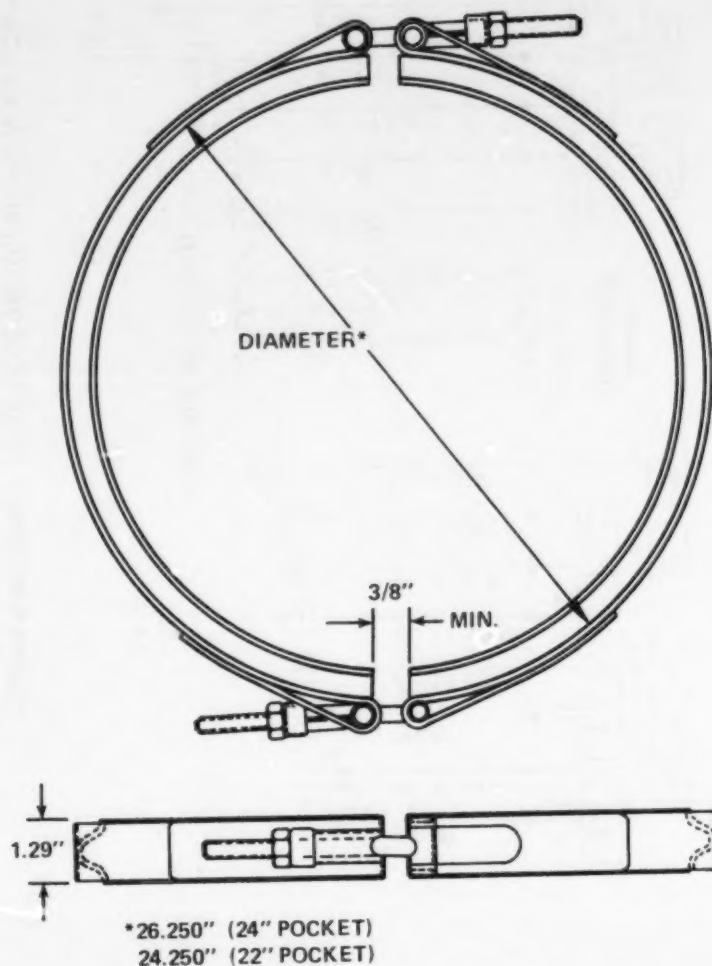


Figure 2-90. Battery pocket V-band coupling (Drawing No. 120380).

Data Sheet 2-D(49). V-band pocket closures.

SWINGBOLT POCKET CLOSURES

Function. Swingbolt pocket closures seal the buoy battery pocket.

Features

- Stainless steel swingbolt
- Rubber gasket

Related Equipment. Swingbolt pocket closures are used on all buoys constructed prior to 1962 and on 1962-type 9X32, 8X26, 5X11, and 3½X8 buoys constructed after 1977. Three types of gaskets are

used on swingbolt pocket closures, as specified in Table 2-14. Replacement swingbolt bolts are available under NSN 5340 00 034 5222 and clevis pins are available under NSN 5315 00 857 1453.

Additional Data. The swingbolt flange shown in Figure 2-93 is now being installed on new buoys. The 1942- and 1952-type swingbolt flanges (Figure 2-94) are similar, but not identical. In addition, some buoys with V-band type closures may have had a swingbolt modification (Figure 2-95).

Table 2-14
Swingbolt Pocket Closure Gaskets

<u>Pocket Diameter (in.)</u>	<u>Gasket</u>	<u>Stock Number</u>
24 (all buoys)	3-in. wide, ¼-in. thick rubber	NSN 5330-01-022-2510
22 (1942 type)	2-in. wide, flat rubber	NSN 5330-00-202-4465 (6-ft buoy) NSN 5330-00-291-0751 (3½- and 5-ft buoys)
22 (1952 type)	¼-in. thick cork	NSN 5330-00-228-6627 (7-, 6-, and 5-ft buoys) NSN 5330-00-228-6626 (3½-ft buoy)

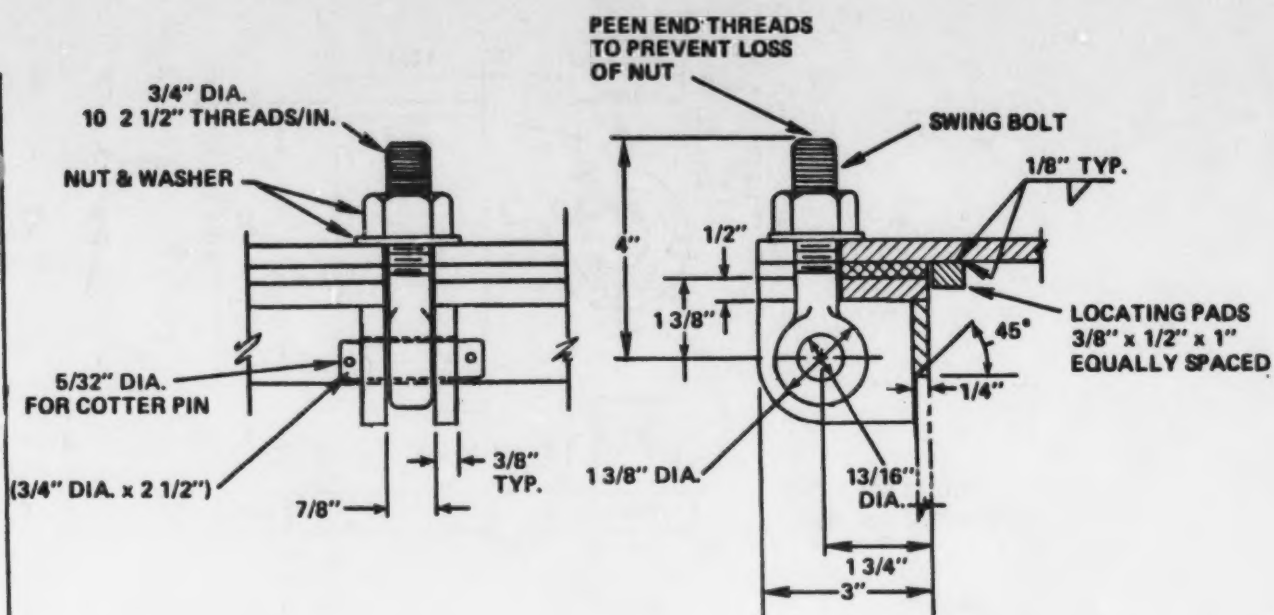


Figure 2-93. Dimensions of swingbolt flange (Drawing No. 121008).

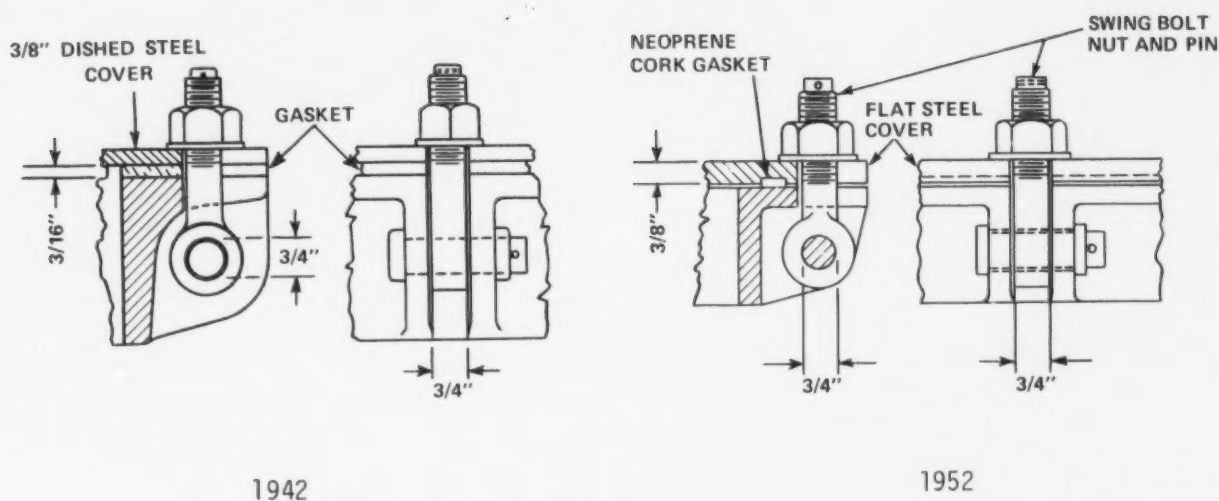


Figure 2-94. 1942- and 1952-type swingbolt pocket covers.

Data Sheet 2-D(50). (cont'd).

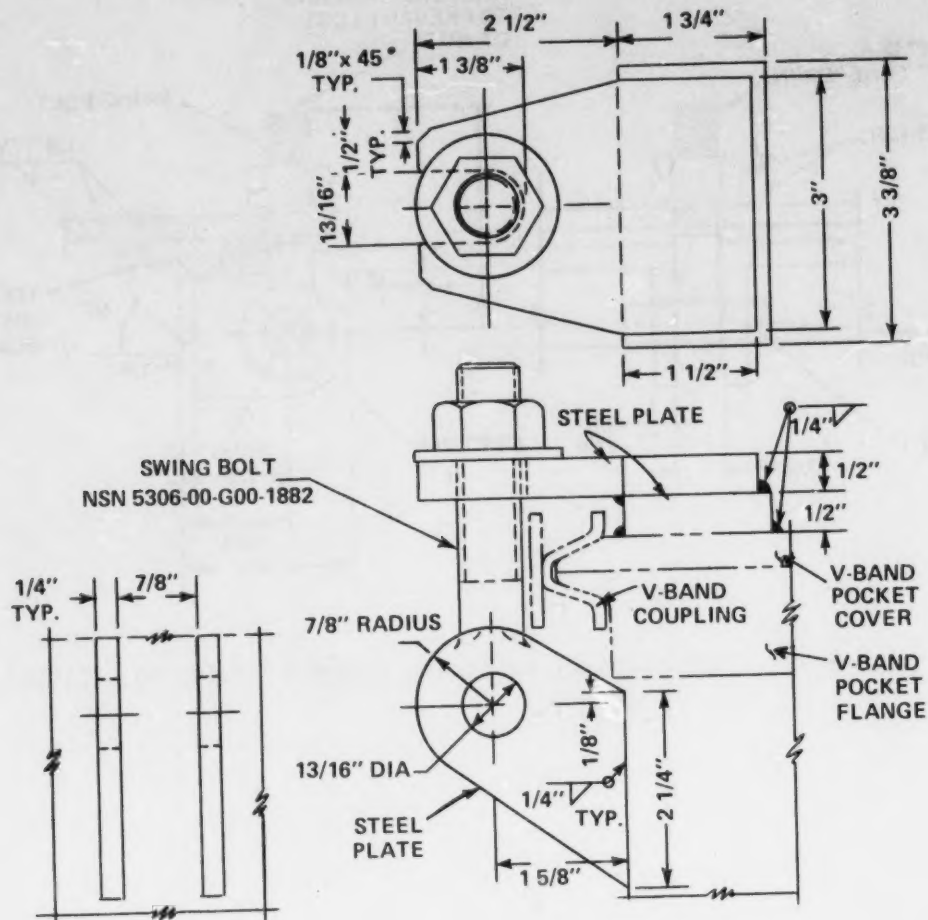


Figure 2-95. Swingbolt modification.

MOORING ARMS

Function. Mooring arms are used on $3\frac{1}{2} \times 8$ (Figure 2-96), 5×11 (Figure 2-97), and 7×17 (Figure 2-98) buoys to extend the bridle connection point downward and prevent chafe of the bridle on the buoy's

counterweight.

Additional Data. The procedure for modification of buoys that do not have mooring arms is shown in CG Drawing No. 120103.

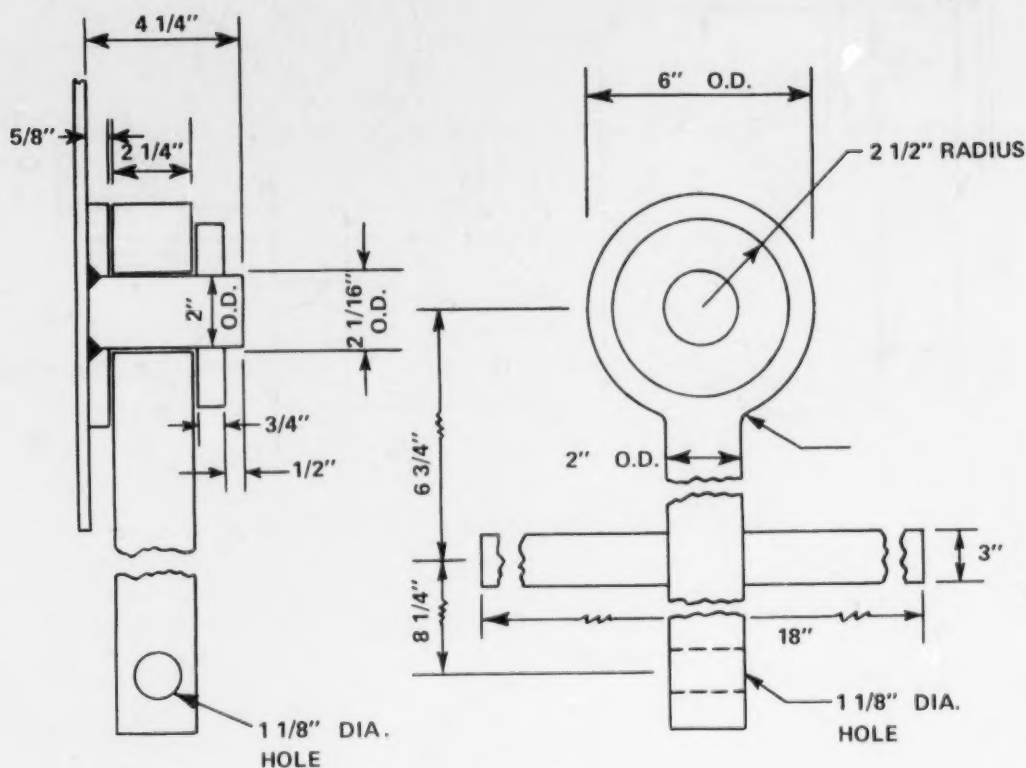


Figure 2-96. Mooring arm for $3\frac{1}{2} \times 8$ LR.

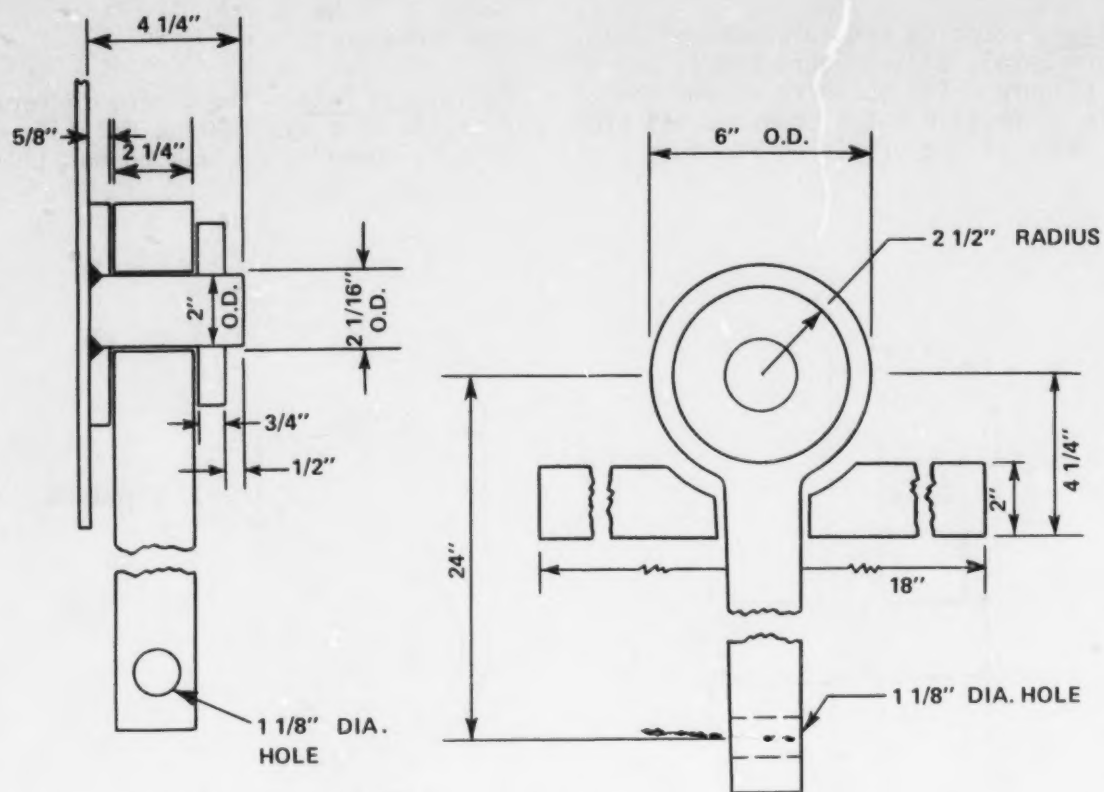


Figure 2-97. Mooring arm for 5X11 LR.

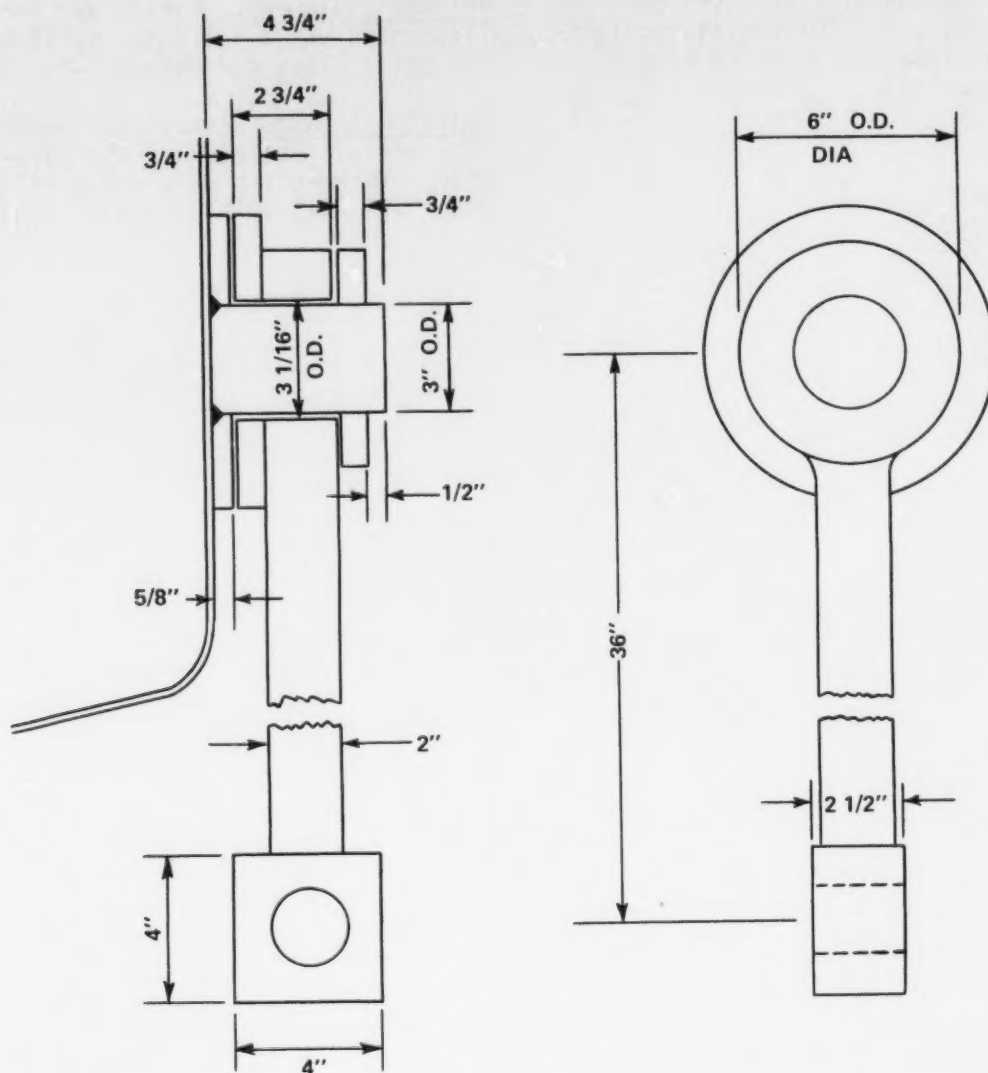


Figure 2-98. Mooring arm for 7X17 LR.

Data Sheet 2-D(51). (cont'd).

MOORING PINS

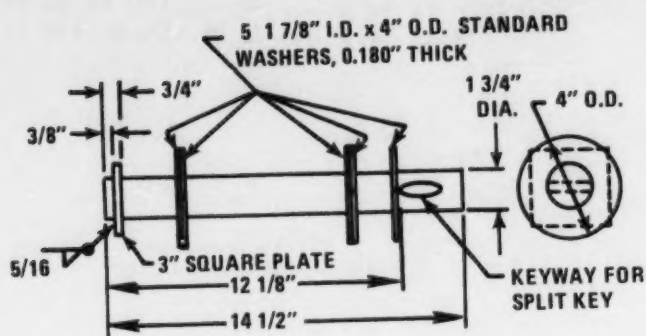
Function. Mooring pins are used on first-, second-, and third-class unlighted buoys to allow worn eyes to be easily replaced on station.

Features

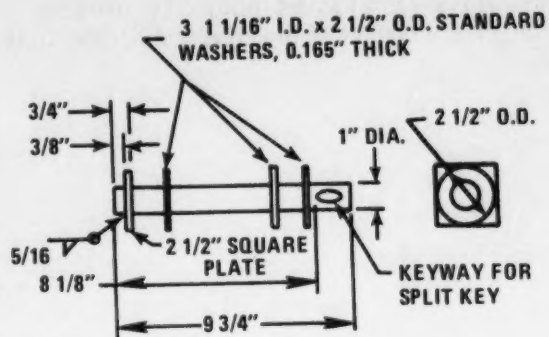
- Mild steel
- Nonrotating
- Split key

Related Equipment. First- and second-class pins use a 1 3/4-in. split key and the third class pin uses a 1-in. split key.

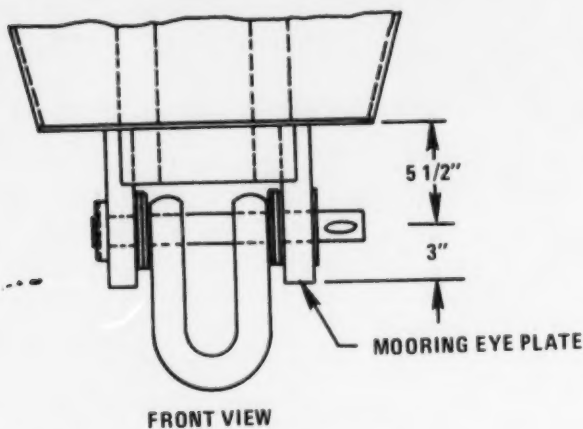
Additional Data. First- and second-class pins are available under NSN 5315-00-243-2570. Third-class pins are available under NSN 5315-00-243-2587.



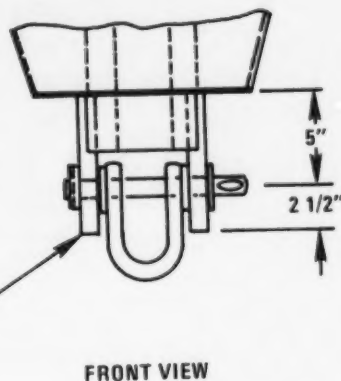
MOORING PIN FOR 1ST AND 2ND CLASS BUOYS



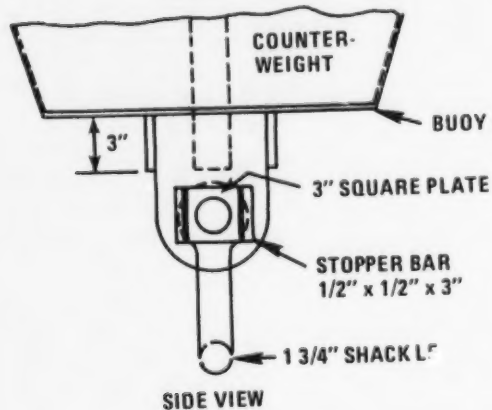
MOORING PIN FOR 3RD CLASS BUOY



FRONT VIEW

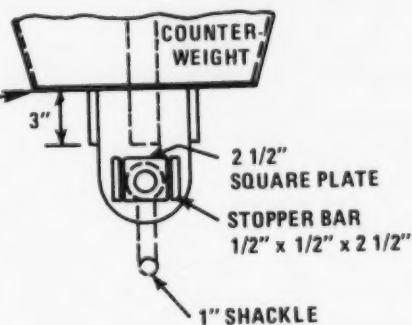


FRONT VIEW



SIDE VIEW

MOORING EYE FOR 1ST AND 2ND CLASS UNLIGHTED BUOYS



SIDE VIEW

MOORING EYE FOR 3RD CLASS UNLIGHTED BUOY

Figure 2-99. Mooring pins for first-, second-, and third-class unlighted buoys.

Data Sheet 2-D(52). (cont'd).

CHAFING BLOCKS

Function. Chafing blocks, made of hard-wood (white oak) or rubber, are mounted on 8- and 9-ft lighted buoys to prevent the bridle from chafing the counterweight tube.

Dimensions

9X32 buoy
8X26 buoy

5½ in.X9½ in.X4 ft
5½ in.X5½ in.X2½ ft

CHAIN

Function. Chain is used to connect the buoy to the sinker.

Features.

- o Steel chain
- o Welded
- o Open link

Dimensions. Chain dimensions are shown in Figure 2-100. The total length of chain used in a buoy mooring is normally from one and one-half (in deep water) to five times the depth (in shallow water).

Related Equipment. The size of chain recommended for a particular buoy is listed on each buoy data sheet.

PHYSICAL REQUIREMENTS			
WIRE DIAMETER (IN)	PROOF STRAIN (LB)	BREAKING STRAIN (LB)	APPROX. WT. PER 15 FATHOMS (LB)
1/2	7,500	15,000	200
3/4	16,000	32,000	435
7/8	22,000	44,000	595
1	29,000	58,000	772
1-1/8	38,500	77,000	969
1-1/4	45,000	91,000	1204
1-1/2	65,500	131,000	1738
1-5/8	76,500	153,000	2027
1-3/4	86,500	173,000	2345
1-7/8	100,000	200,000	2685

CHAIN DIMENSIONS (IN.)								
A	COMMON LINKS				END LINKS			I
	B	C	D	E	F	G	H	
WIRE DIAMETER	LENGTH	WIDTH	SPACE BETWEEN ENDS OF LK.	TOLERANCE	WIRE DIAMETER	LENGTH	WIDTH	TOLERANCE
1/2	3	1-7/8	1	± 1/32	3/4	4-1/2	2-5/8	± 1/16
3/4	4-1/2	2-5/8	1-1/2	± 1/16	7/8	5-1/4	3-1/8	± 1/16
7/8	5-1/4	3-1/8	1-3/4	± 1/16	1-1/8	6-3/4	3-7/8	± 3/32
1	6	3-1/2	2	± 3/32	1-1/4	7-1/2	4-3/8	± 1/8
1-1/8	6-3/4	3-7/8	2-1/4	± 3/32	1-1/4	7-1/2	4-3/8	± 1/8
1-1/4	7-1/2	4-3/8	2-1/2	± 1/8	1-1/2	9	5-1/4	± 5/32
1-1/2	9	5-1/4	3	± 5/32	1-7/8	11-1/4	6-1/2	± 3/16
1-5/8	9-3/4	5-11/16	3-1/4	± 5/32	1-7/8	11-1/4	6-1/2	± 3/16
1-3/4	10-1/2	6-1/16	3-1/2	± 3/16	2-1/8	12	7-3/16	± 7/32
1-7/8	11-1/4	6-1/2	3-3/4	± 3/16	2-1/8	12	7-3/16	± 7/32

Figure 2-100. Chain characteristics.

Data Sheet 2-D(54). Chain.

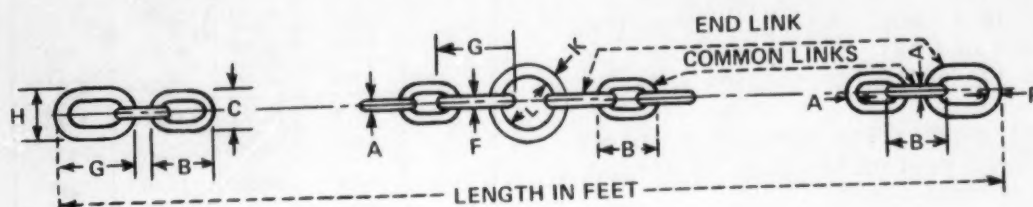
BRIDLES

Function. Bridles are used to distribute the mooring loads and prevent large heel angles in the buoys.

- Welded
- Open Link
- Special End Links

Features.

- Steel



TYPE OF BUOY	BRIDLE DIMENSIONS (IN.)								NUMBER OF COMMON LINKS	LENGTH (FT)	APPROXIMATE WEIGHT (LB)
	COMMON LINKS			END LINKS			CENTER RING				
	A	B	C	F	G	H	K	L			
10 x 39 LW	1 1/2	9	5 1/4	1 7/8	11 1/4	6 1/2	2 1/4	8	44	26	557
9 x 39 LW	1 1/2	9	5 1/4	1 7/8	11 1/4	6 1/2	2 1/4	8	44	26	557
9 x 38 LW	1 1/2	9	5 1/4	1 7/8	11 1/4	6 1/2	2 1/4	8	44	26	557
9 x 32 LR, LBR, LGR, LWR	1 1/2	9	5 1/4	1 7/8	11 1/4	6 1/2	2 1/4	8	28	18	400
9 x 13 B, 8 x 13 B, 9 x 14 B	1 1/4	7 1/2	4 3/8	1 1/2	9	5 1/4	1 3/4	6	52	25	346
6 x 24 LI	1 1/4	7 1/2	4 3/8	1 1/2	9	5 1/4	1 3/4	6	48	23	305
9 x 20 BR, GR	1 1/4	7 1/2	4 3/8	1 1/2	9	5 1/4	1 3/4	6	28	15	212
8 x 26 LR, LBR, LGR, LWR	1 1/4	7 1/2	4 3/8	1 1/2	9	5 1/4	1 3/4	6	28	15	212
8 x 23 LW	1 1/4	7 1/2	4 3/8	1 1/2	9	5 1/4	1 3/4	6	28	15	212
8 x 20 LB, LG	1 1/4	7 1/2	4 3/8	1 1/2	9	5 1/4	1 3/4	6	28	15	212
8 x 23 L, LB	1 1/4	7 1/2	4 3/8	1 1/2	9	5 1/4	1 3/4	6	28	15	212
7 x 17 LR	1 1/4	7 1/2	4 3/8	1 1/2	9	5 1/4	1 3/4	6	28	15	212
7 x 15 L	1 1/4	7 1/2	4 3/8	1 1/2	9	5 1/4	1 3/4	6	28	15	212
7 x 23 W	1 1/4	7 1/2	4 3/8	1 1/2	9	5 1/4	1 3/4	6	28	15	212
7 x 18 L	1	6	3 1/2	1 1/4	7 1/2	4 3/8	1 3/4	6	36	15	135
6 x 20 LR, LBR	1	6	3 1/2	1 1/4	7 1/2	4 3/8	1 3/4	6	28	12	120
5 x 11 LR	1	6	3 1/2	1 1/4	7 1/2	4 3/8	1 3/4	6	28	12	120
5 x 10 L	1	6	3 1/2	1 1/4	7 1/2	4 3/8	1 3/4	6	28	12	120
3 1/2 x 8 LR	7/8	5 1/4	3 1/8	1 1/8	6 3/4	3 7/8	1 1/4	6	28	10	70
3 1/2 x 10 L	7/8	5 1/4	3 1/8	1 1/8	6 3/4	3 7/8	1 1/4	6	28	10	70

Figure 2-101. Bridge characteristics.

Data Sheet 2-D(55). Bridges.

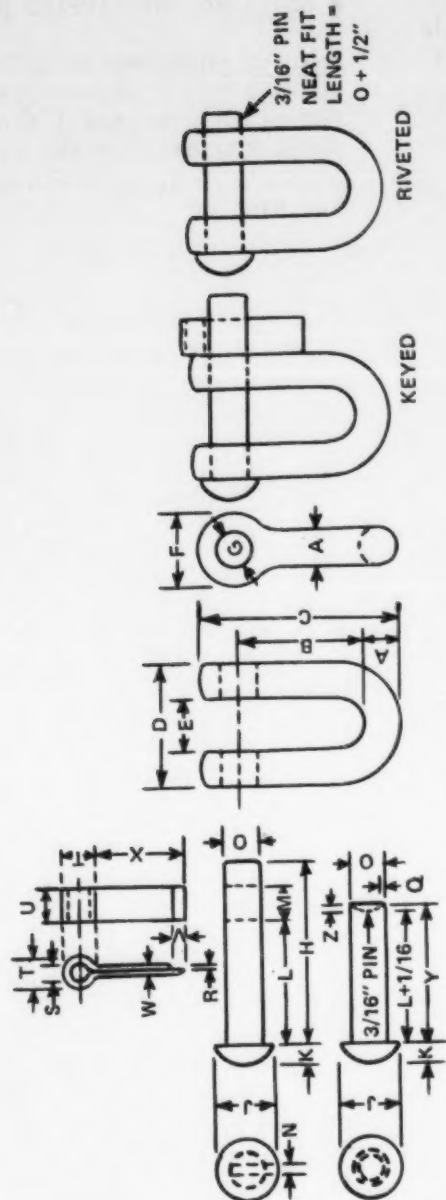
SHACKLES

Function. Shackles are used to connect lengths of chain to each other and to swivels, bridles, sinkers, and buoys. They are available in either split-key or riveted-pin types. Split-key shackles shall be used where relatively frequent opening of the shackle is required, such as the mooring chain/bridle connection. Riveted-pin shackles are used mainly in the chafe section or for splicing sections of chain together.

Features

- Steel
- Split key or riveted pin

Related Equipment. Split-key shackles require a split key--a piece of flat steel (or stainless steel) bent so that the fold forms the head of the key and the tail can be separated, in the same manner as a cotter pin.



TYPE	SHACKLE DIMENSIONS (IN.)																								STRAIN (LB.)		
	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	BREAKING	PROOF
A	7 3/4	11 7/8	7	3	4 1/4	2 1/16	9 1/2	3	1 1/8	7 1/16	17/16	7/16	2		3/16	3/16	9/16	15/16	1 1/4	3/8	3/8	4	8	3/8		226,200	113,100
2	6 7/8	10 1/2	6 1/4	2 3/4	3 3/4	1 13/16	8 3/4	2 3/4	1	6 5/16	17/16	7/16	1 3/4		3/16	3/16	9/16	15/16	1 1/4	3/8	3/8	4	7 1/8	3/8		172,800	86,400
1 3/4	5 1/4	8 3/8	5 1/4	2 1/4	3 1/4	1 9/16	7 3/4	2 1/2	7/8	5 5/16	17/16	7/16	1 1/2		3/16	3/16	9/16	15/16	1 1/4	3/8	3/8	4	5 7/8	1/4		126,700	63,350
1 1/2	4 1/8	6 1/8	4 1/4	2 1/4	2	1 1/16	6	1 5/8	5/8	4 5/16	1 1/16	5/16	1		1/8	1/8	9/16	13/16	7/8	3/8	1/4	4	4 7/8	1/4		57,000	28,500
1																											
2 1/2	9	14 1/4	11	6	5 1/2	2 9/16	13 5/8	3 1/2	1 3/8	11 1/8	17/16	9/16	2 1/2				1/4	9/16	1	1 1/4	3/8	1/2	4 1/2			352,800	176,400

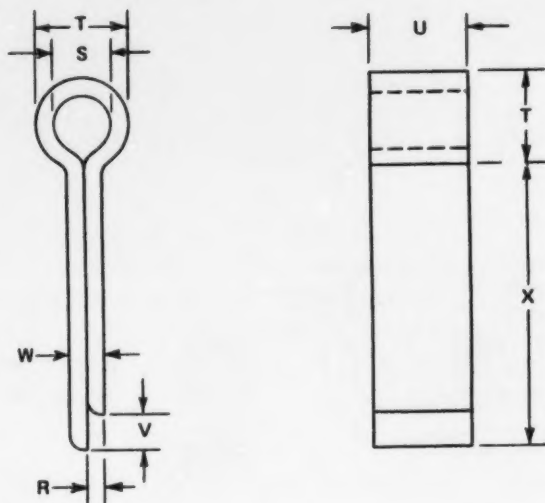
Data Sheet 2-D(56). (cont'd)

Figure 2-102. Shackle characteristics.

SPLIT KEYS

Function. A split key, made of stainless steel or steel, is used with a split-key shackle. The key is inserted into the shackle pin and bent open to prevent the pin from backing out.

Related Equipment. Figure 2-102 on Data Sheet 2-D(56) shows what size of key is required for a particular shackle.



SPLIT KEY DIMENSIONS (IN.)			
	1ST, 2ND, & 3RD CLASS	4TH CLASS	SPECIAL
R	3/16	1/8	~~1/4~~ 3/16
S	9/16	9/16	9/16
T	15/16	13/16	1 1/16
U	1 1/4	7/8	1 1/4
V	3/8	3/8	3/8
W	3/8	1/4	~~1/2~~ 3/8
X	4	4	~~4 1/2~~ 5

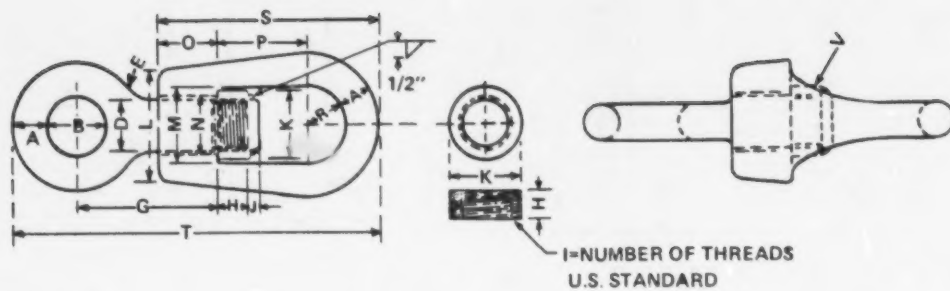
Figure 2-103. Split key dimensions.

Data Sheet 2-D(57). Split keys.

SWIVELS

Function. A steel swivel is included in the mooring to allow the buoy to twist without causing the chain to twist or kink. Swivels are mounted just below the

bridle and just before the riser chain. They can be placed approximately one shot below the bridle, but never in the chafe.



TYPE	SWIVEL DIMENSIONS (IN.)																				STRAIN (LB.)			
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	BREAKING	PROOF
2	3		3	15/8		7 1/4	1 1/2	3 1/2	1/2	4	6	43/8	3 1/4	3	4 3/4	2 1/4	12	19 3/4		9			163,000	81,500
1 3/4	2 3/4		2 1/2	1 3/8		6 5/8	1 1/2	4	1/2	3 1/4	5	3 5/8	2 3/4	2 3/4	4 3/8		1 7/8	10 3/4	17 3/4		8		118,000	59,000
1 1/2	2 1/2		2 1/4	1 1/4		6	1 1/4	4 1/2	1/2	3	4 1/2	3 1/4	2 1/2	2 1/2	3 7/8		1 5/8	9 1/2	15 3/4		7		90,000	45,000
1 1/4	2 1/4		2	1 1/8		4 7/8	1 1/4	4 1/2	1/2	2 3/4	4	3	2 1/4	2	3		1 1/2	7 3/4	13		6 1/2		60,000	30,000

Figure 2-104. Swivel characteristics.

Data Sheet 2-D(58). Swivels.

BALLAST BALLS

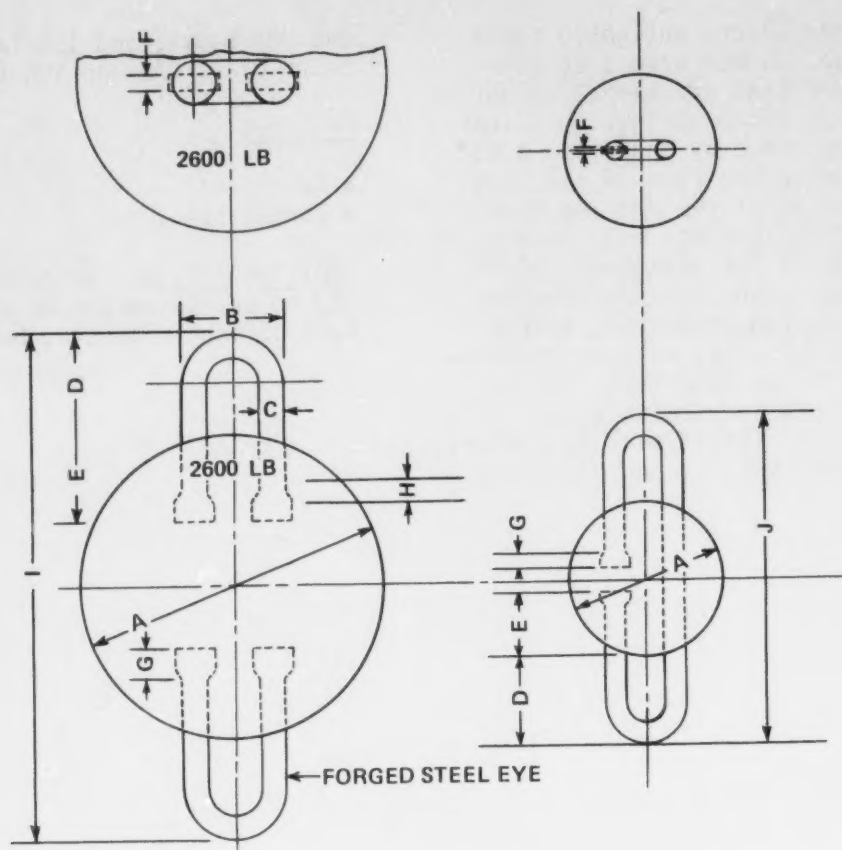
Function. Many older, unlighted buoys (pre-1942 type) do not have a counterweight and need some additional weight to make them float in an upright position. This is accomplished by shackling a ballast ball between the foot of the buoy and the beginning of the mooring chain. The weight of the ballast ball varies, as follows: 2600 lb for unlighted, 1928-type bell buoys without fixed counterweight; 2000 lb for 1928-type, first-class CAN and NUN buoys without counterweight; 1260 lb for 1928-type, first-class CAN and NUN buoys with added counterweight and 1942-type 7X15 L buoys; 410 lb for 1928-type, second-class CAN

and NUN buoys; and 120 lb for 1928-type, third-class CAN and NUN buoys.

Features

- Cast iron
- Forged steel eye

Additional Data. In deep water, there may be enough weight of chain to keep the buoy upright without a ballast ball.



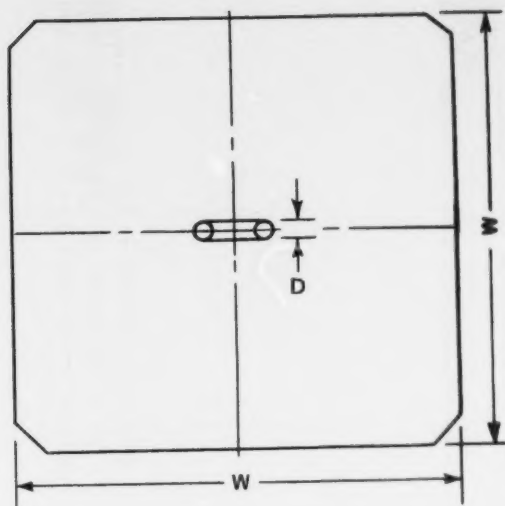
BALLAST BALL DIMENSIONS (IN.)										WEIGHT (LB)
A	B	C	D	E	F	G	H	I	J	
26 1/4	8	2	8 1/2	7	1	3	2	43 1/4		2,600
24	8	2	8 1/2	7	1	3	2	41		2,000
20 1/2	8	2	8 1/2	7	1	3	2	37 1/2		1,260
17 3/4	6 1/2	1 5/8	7 1/2	5	13/16	2 1/2	1 5/8	32 3/4		830
14	5 1/2	1 3/8	7	5	11/16	2 1/2	1 3/8	28		410
12 1/2	5 1/2	1 3/8	7	4 1/2	11/16	2 1/4	1 3/8		26 1/2	290
11	5 1/2	1 3/8	7	4	11/16	2	1 3/8		25	205
9 1/4	5	1 1/4	7	3 1/2	5/8	1 1/2	1 1/4		23 1/4	120

Figure 2-105. Ballast ball characteristics.

Data Sheet 2-D(59). (cont'd).

SINKERS

Function. Concrete sinkers are used to hold the buoy in position.



CONCRETE BUOY SINKER DIMENSIONS (IN.)						
W	L	H	E	D	O	WEIGHT (LB)
60	5 1/4	42	5 1/2	2	22 1/2	12,750
60	5 1/4	28	5 1/2	2	22 1/2	8,500
58	5 1/4	23	5 1/2	2	22 1/2	6,500
54	5 1/4	21	5 1/2	2	22 1/2	5,000
50	5 1/4	19	5 1/2	2	22 1/2	4,000
45	5 1/4	18	5 1/2	2	22 1/2	3,000
40	5 1/4	15	5 1/2	1 1/2	19	2,000
32	5 1/4	12	5 1/2	1 1/2	16	1,000
24	5 1/4	10	5 1/2	1 1/2	14	500
20	5 1/4	8	5 1/2	1 1/2	12	250

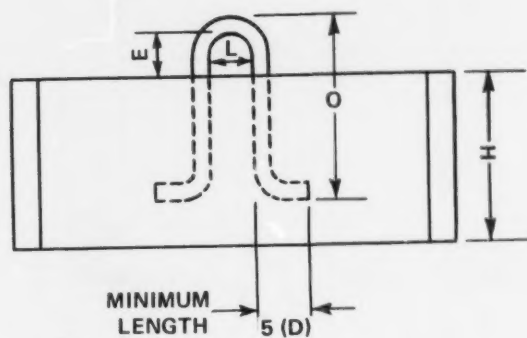
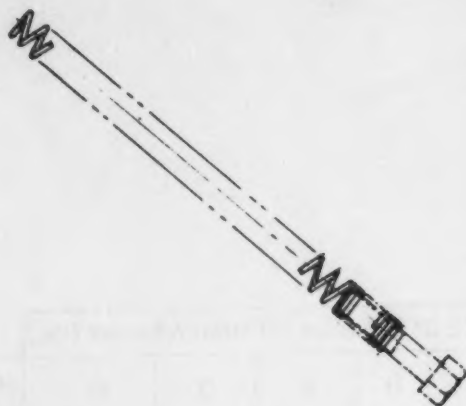


Figure 2-106. Buoy sinker characteristics.

Data Sheet 2-D(60). Sinkers.

BIRD SPRINGS

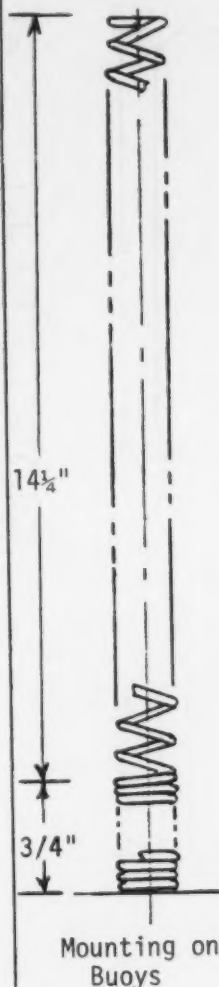


Function. Bird Springs are stainless steel helical springs mounted on the tops of buoys (3rd class and larger) and structures designed to keep birds from roosting on the aids. This in turn reduces the bird fouling on the aids.

Physical Characteristics. The springs are made of stainless steel (Class 302 or 304). Each spring is compression wound with one "open-pitch" section (14½ inches) and one "closed-pitch" section (¾ inches) which makes a screw-fit with a ¾ - 16 bolt for installation.

Operational Characteristics. Testing has shown that the springs are of sufficient flexibility such that their motion on the aid harasses the birds, preventing them from perching. Originally designed for buoys, the springs have been used on fixed aids also. This technique requires the spring to be installed "upside-down". The mounting bolt is screwed into the "open-pitch" section. This positions the weighted "closed-pitch" section at the free end. The wind is relied on to sufficiently activate the springs into motion in the fixed structure arrangement.

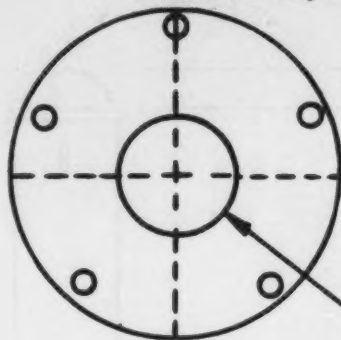
Additional Data. The Bird Springs are available through the Supply Center in Brooklyn, New York. The springs shall be issued in bundles of 25 each. (NSN 5360-01-100-3111). Units must supply the ¾ inch stainless steel bolts required for installation. A schematic layout for arrangement of the springs on buoys is provided on the following page.



MUST mate with
¾ - 16 bolt



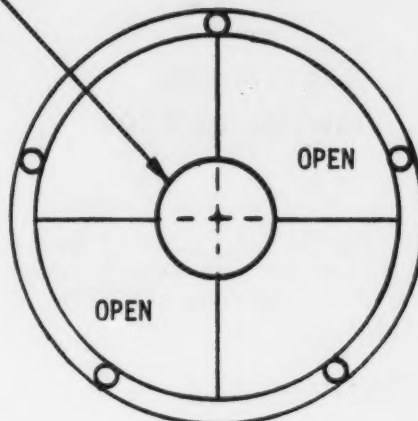
Schematic Layout of Bird Spring Arrangement on Lantern Rings



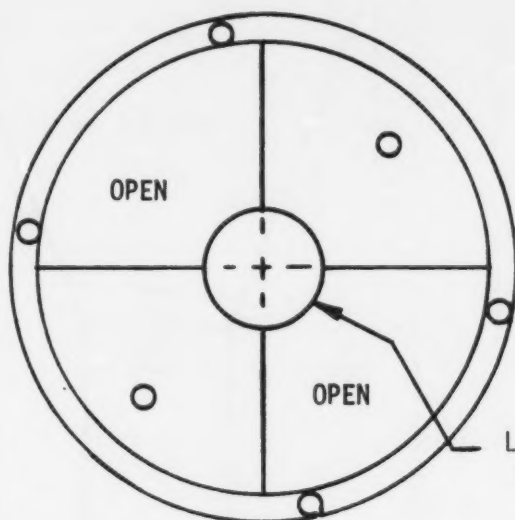
For use on 3½ and 5 ft buoys, three inches shall be cut from the open pitch section of the spring to avoid beating against the lantern

3½ X 8 LR and 5 X 11 LR

LANTERN
AREA

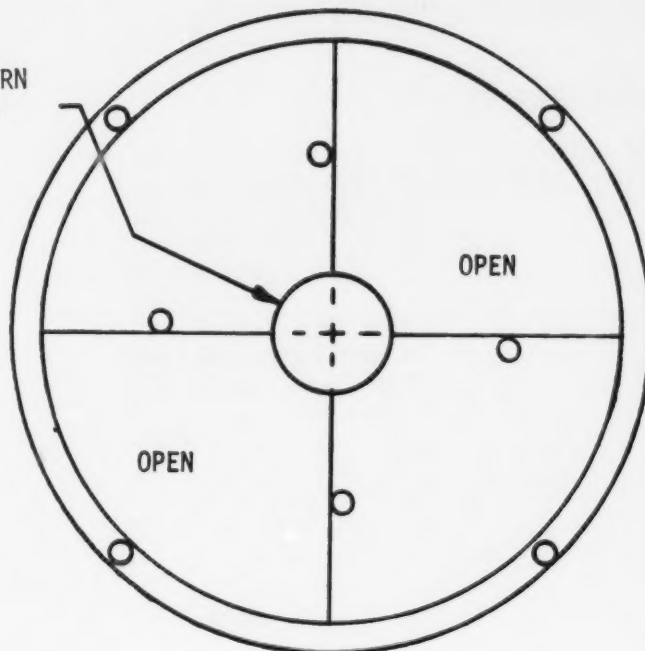


6 X 20 LR



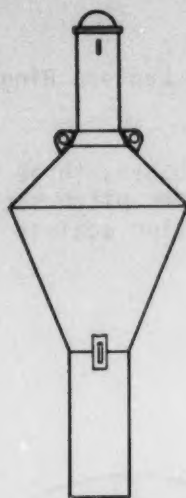
7 X 17 LR

LANTERN
AREA



8 X 26 LR

○ DENOTES APPROXIMATE
LOCATION OF SPRINGS
(This allows for proper
coverage of the area without
the springs tangling or
beating against the lantern.)



STANDARD LIGHTED ICE BUOY

Function. The 6x16 LI buoy is designed and constructed for use as a lighted seasonal aid on stations subjected to ice conditions.

Physical Characteristics.

Buoy weight	4,460 lbs.
Buoy draft (no mooring)	9 ft.-5 in.
Freeboard (no mooring)	3 ft.-1 in.
Pounds per inch of immersion	140.1
Focal height of light (no mooring)	7 ft.-0 in.

Related Equipment.

Power unit	ice buoy dry cell
Mooring chain size	retain mooring on
Sinker	aid being replaced,
	but use 3/4" riser chain
Optic	Hemispherical Lexan
	dome with modified
	155 mm lens (optional)

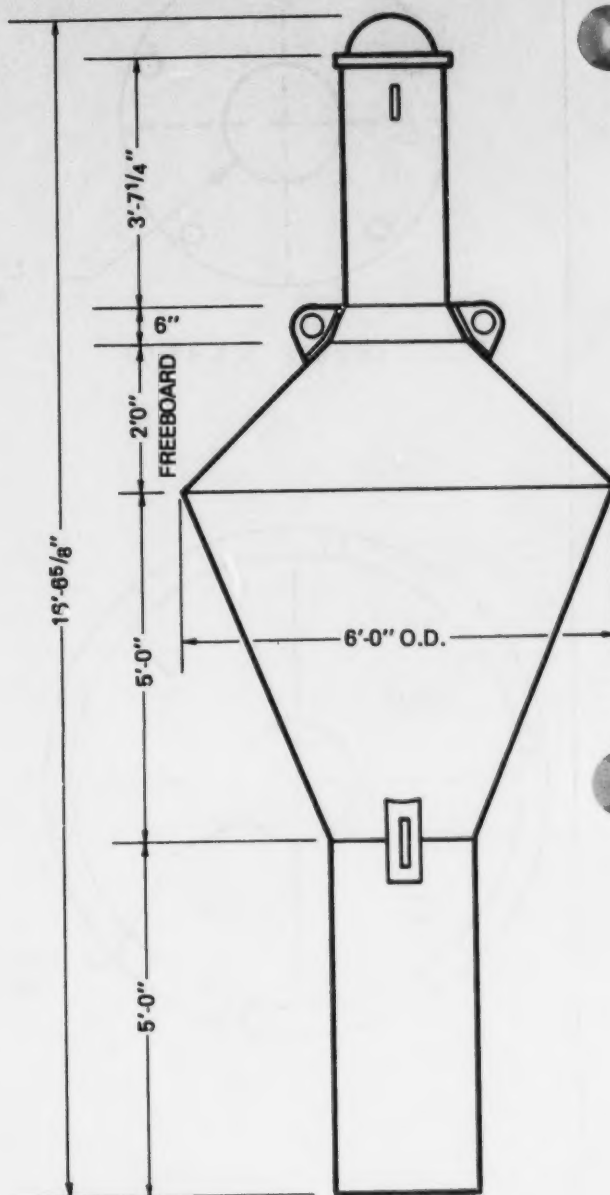


Figure 2-22A Dimensions of the 6x16 LI

Data Sheet 2-D(11A) 6x16 LI Buoy

CHAPTER 3 BUOY MARKINGS

A. Selection Guide. Select the marking scheme for buoys by referring to the Aids to Navigation Manual-Administration (COMDTINST M16500.7).

B. Preparation and Installation. After the marking scheme selection has been completed, the data sheets in this chapter are the guides for buoy appearance. The actual mechanics of preparing and installing a buoy are outlined in chapter 2 of this volume, where reference is made to both chapter 4 of the Coatings and Color Manual (COMDTINST M10360.3) and to this chapter. The Coatings and Color Manual provides information on how to apply the markings. This chapter explains where to place the markings by including illustrations of marked buoys on the data sheets, along with notes for clarification of color, sizes, and positions. Note: The U.S. Coast Guard conducts extensive tests to determine what types of films are suitable for use in a marine environment. Qualified films are published on a Qualified Products List (QPL). The QPL is available from G-EOE 202-426-1102. Only qualified films shall be used as buoy markings.

C. Inspection, Maintenance and Repair On Station.

Maintenance/Inspection Schedule. Inspect all buoys annually.

Maintenance/Inspection Requirements. Cuts and abrasions over 6 in. in length, or those which penetrate the old coating through to bare metal, shall be repainted. If more than 25 percent of the surface area presented as a visual signal is obscured with bird fouling, marine growth, or physical deterioration (peeling, scaling, etc.), the area should be cleaned or painted to present a "like new" appearance. Painting procedures are specified in the Coatings and Color Manual.

D. GENERAL DESCRIPTION DATA SHEETS

LATERAL PORT MARKS

Radar Reflector Type:

Color. Green (Munsell chip number 2.5G5/12).

Characters. Largest, odd, white retroreflective NUMERAL, not to exceed 16 in., that will fit in the available area without crowding. Located as far right as possible on each right-hand radar reflector. Multiple characters are displayed horizontally (side by side).

Retro Panels. Green panels, one on each left-hand radar reflector; height to fit in area of reflector and width up to 12 in.

Nonradar Reflector Type:

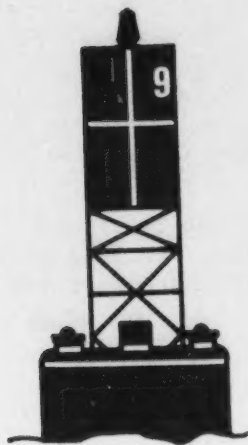
Color. Same as for Radar Reflector Type.

Characters. Largest, odd, white retroreflective NUMERAL, not to exceed 16 in. or one-quarter of the buoy freeboard, that will fit without crowding. Located under or beside retro panels on each daymark plate (lighted) or in three sets spaced 120° apart (unlighted). Multiple characters are displayed horizontally (side by side).

Retro Panels. Green panels, one sized to fit each daymark plate, with a minimum width of 6 in. (lighted), or three panels spaced 120° apart, with a height of 6 in. and a width of two-thirds of the buoy diameter at the point of attachment (unlighted).

Note. Plastic radar reflecting buoys shall be marked like metal nonradar reflecting buoys because they both have similar shapes.

Lighted



Unlighted

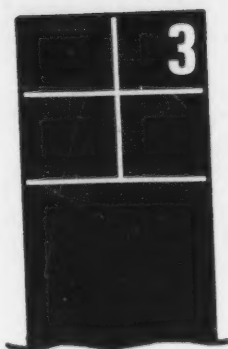


Figure 3-2. Lateral port marks.

Data Sheet. 3-D(1). (cont'd)

LATERAL STARBOARD MARKS

Radar Reflector Type:

Color. Red (Munsell chip number 7.5R4/16)

Characters. Largest, even, white retroreflective NUMERAL, not to exceed 16 in., that will fit in the available area without crowding. Located offset to the right, on each right-hand radar reflector. Multiple characters are displayed horizontally (side by side).

Retro Panels. Red panels, one on each left-hand radar reflector; height to fit in area of reflector and minimum width of 6 in.

Nonradar Reflector Type:

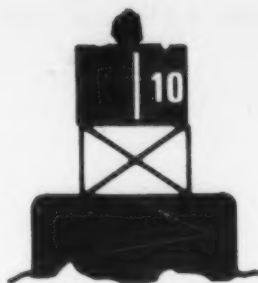
Color. Same as for Radar Reflector Type.

Characters. Largest, even, white retroreflective NUMERAL, not to exceed 16 in. or one-quarter of the buoy freeboard. Located under or beside retro panels on each daymark plate (lighted) or in three sets spaced 120° apart (unlighted). Multiple characters are displayed horizontally (side by side).

Retro Panels. Red panels, one sized to fit each daymark plate, with a minimum width of 6 in. (lighted), or three panels spaced 120° apart, with a height of 6 in. and a width of two-thirds of the buoy diameter at the point of attachment (unlighted).

Note: Plastic radar reflecting buoys shall be marked like metal nonradar reflecting buoys because they both have similar shapes.

Lighted



Unlighted



Figure 3-3. Lateral starboard marks.

Data Sheet 3-D(2). (cont'd)

SAFEWATER MARKS

Radar Reflector Type:

Color. Alternating red and white vertical stripes. (Munsell chip number 7.5R4/16 for red, Federal color number 27875 for white.)*

Characters. Largest, white retroreflective LETTER, not to exceed 16 in., that will fit in the available area without crowding. Located offset to the right, on the red, right-hand radar reflector. Multiple characters are displayed horizontally (side by side).

Retro Panels. White panels, one on each white left-hand radar reflector vane; height to fit in area of reflector and minimum width of 6 in.

*Note: Federal color numbers refer to Federal Standard 595a "Color".

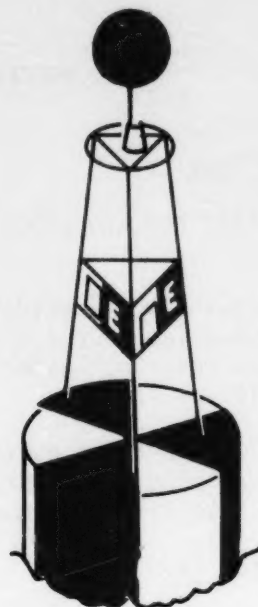
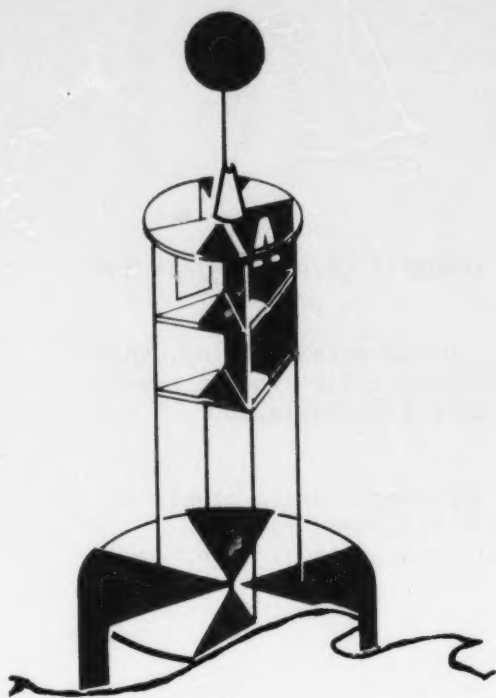
Nonradar Reflector Type:

Color. Six alternating red and white vertical stripes same colors as radar reflector type.

Characters. Largest, white retroreflective LETTER, not to exceed 16 in. or one-quarter of the buoy freeboard. Located on the red right-hand side of each daymark plate, (lighted) or in three sets centered on each red vertical stripe (unlighted). Multiple characters are displayed horizontally (side by side).

Retro Panels. White panels, one on the white left-hand side of each daymark plate, with a height to fit on the plate and a minimum width of 6 in. (lighted), or three panels, one centered on each white vertical stripe (unlighted), with a minimum size of 1 sq ft each.

Lighted



Unlighted



Figure 3-4. Lateral safe water marks.

Data Sheet 3-D(3). (cont'd)

PREFERRED CHANNEL MARKS

Radar Reflector Type:

Color. Alternating red and green horizontal bands (Munsell chips 7.5R4/16 and 2.5G5/12).

Characters. Largest, white retroreflective LETTER, not to exceed 16 in., that will fit in the available area without crowding. Located offset to the right, on the right-hand radar reflector. Multiple characters are displayed horizontally (side by side).

Retro Panels. Red panels on buoys with a red band uppermost, green panels on buoys with a green band uppermost. One panel on each left-hand radar reflector; height to fit in area of reflector and minimum width of 6 in.

Nonradar Reflector Type:

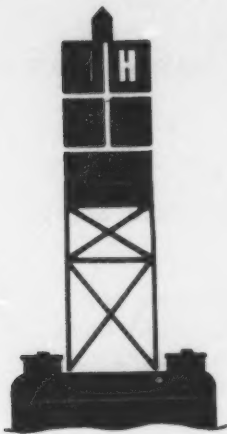
Color. Same as for Radar Reflector Type.

Characters. Largest, white retroreflective LETTER, not to exceed 16 in. or one-quarter of the buoy freeboard. Located under or beside retro panels on each daymark plate (lighted) or in three sets spaced 120° apart (unlighted). Multiple characters are displayed horizontally (side by side).

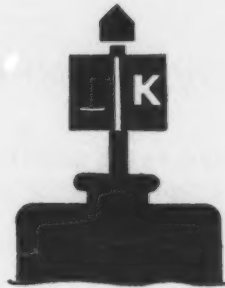
Retro Panels. Red panels on buoys with a red band uppermost, green panels on buoys with a green band uppermost. One panel on each daymark plate, with a height to fit on the plate and a minimum width of 6 in. (lighted), or three panels spaced 120° apart, with a height of 6 in. and a width of two-thirds of the buoy diameter at the point of attachment (unlighted).

Note: Plastic radar reflecting buoys shall be marked like metal nonradar reflecting buoys because they both have similar shapes.

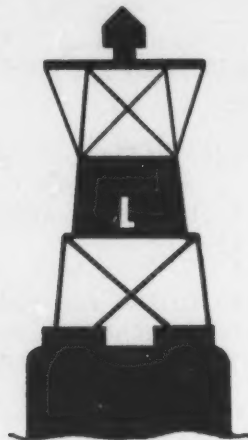
Lighted



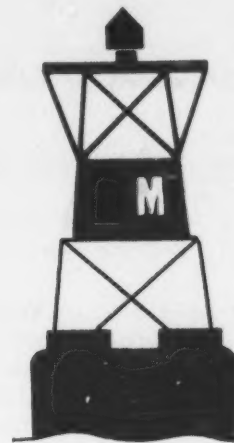
PREFERRED CHANNEL
TO STARBOARD
TOP BAND BLACK



PREFERRED CHANNEL
TO PORT
TOP BAND RED

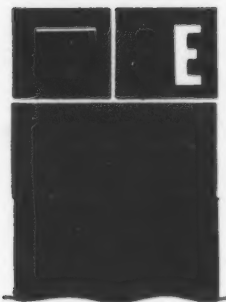


PREFERRED
CHANNEL TO
STARBOARD



PREFERRED
CHANNEL TO
PORT

Unlighted



*Because of the small surface area available for the alternate color on 1952-, 1942-, or 1928-type lighted buoys, they shall not be installed as junction markers. Existing buoys shall be changed to the 1962-type at the next relief.

Figure 3-5. Preferred channel marks.

Data Sheet 3-D(4). (cont'd).

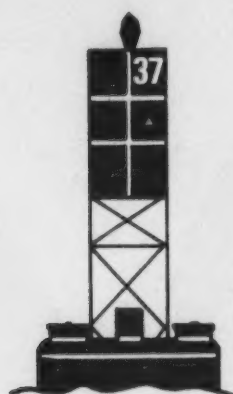
INTRACOASTAL WATERWAY DUAL-PURPOSE PORT, STARBOARD, PREFERRED CHANNEL MARKS

Marking: Radar and Nonradar Reflector Types

Color. Identical to port starboard, and preferred channel marks (Data Sheets 3-D(T), 3-D(2), and 3-D(4)).

Retro Panels. In addition to the red and green retro panels outlined for port, starboard, and preferred channel marks, dual-purpose marks shall have squares and triangles made from yellow reflective material. The squares indicate that the aid is a port mark for the intracoastal waterway, regardless of the color or number of the aid. Conversely, triangles indicate a starboard side mark for the intracoastal waterway. The size of a square should be between 3 and 6 in. on a side and the size of a triangle should be between 4 and 6 in. on a side, depending on available mounting area and the requirement that the area of the square or triangle shall not exceed one-quarter of the area of the red or green retro panel used to note the primary channel markings. Locate the dual-purpose markers beneath each combination of primary channel characters/retro-panel markings using the available space on radar reflector vanes, daymark plates, or the buoy body, as shown in Figure 3-6.

Data Sheet 3-D(5). Intracoastal waterway dual-purpose port, starboard, and preferred channel marks.



STARBOARD



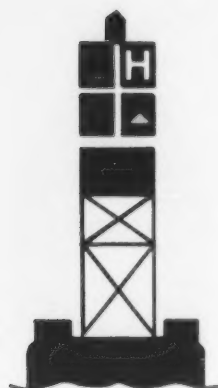
PORT



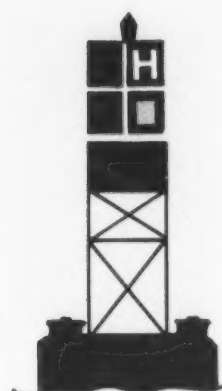
PORT



STARBOARD

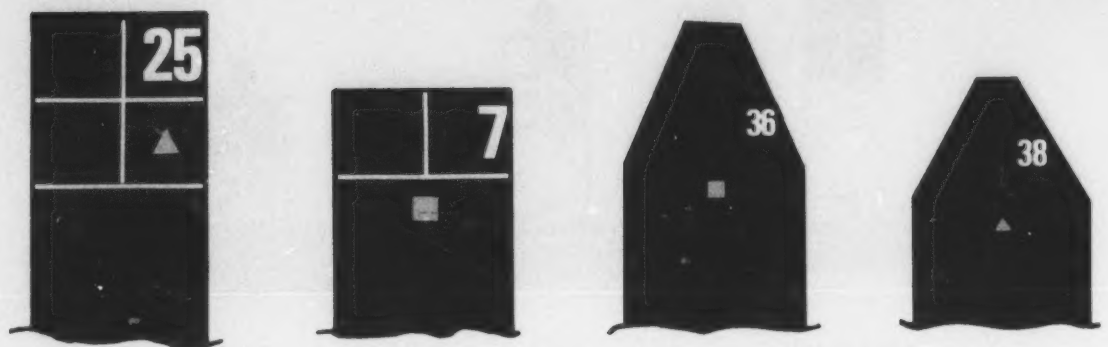


PREFERRED
CHANNEL TO
PORT



PREFERRED
CHANNEL TO
STARBOARD

Figure 3-6(a). Intracoastal waterway dual purpose port, starboard, and preferred channel marks.



STARBOARD

PORT

PORT

STARBOARD



PORT

PREFERRED
CHANNEL TO
STARBOARD

PREFERRED
CHANNEL TO
PORT

Figure 3-6(b). Intracoastal waterway dual purpose port, starboard, and preferred channel marks.

INTRACOASTAL WATERWAY PORT, STARBOARD, PREFERRED CHANNEL
AND SAFEWATER MARKS

Markings: Radar and Nonradar Reflector Types

Color. Same as specified for the U.S. Marking System (Data Sheets 3-D(1) through 3-D(4)).

Retro Panels. Same as specified for the U.S. Marking System (Data Sheets 3-D(1) through 3-D(4)), plus an additional strip of yellow reflective tape at least 1 in. wide, but no wider than 2 in., located beneath each character/retro panel combination. Application is similar for all functions--port, starboard, preferred channel and safewater; therefore, only representative samples of each are shown in Figure 3-7.

Data Sheet 3-D(6). Intracoastal waterway port, starboard, preferred channel and safewater marks.

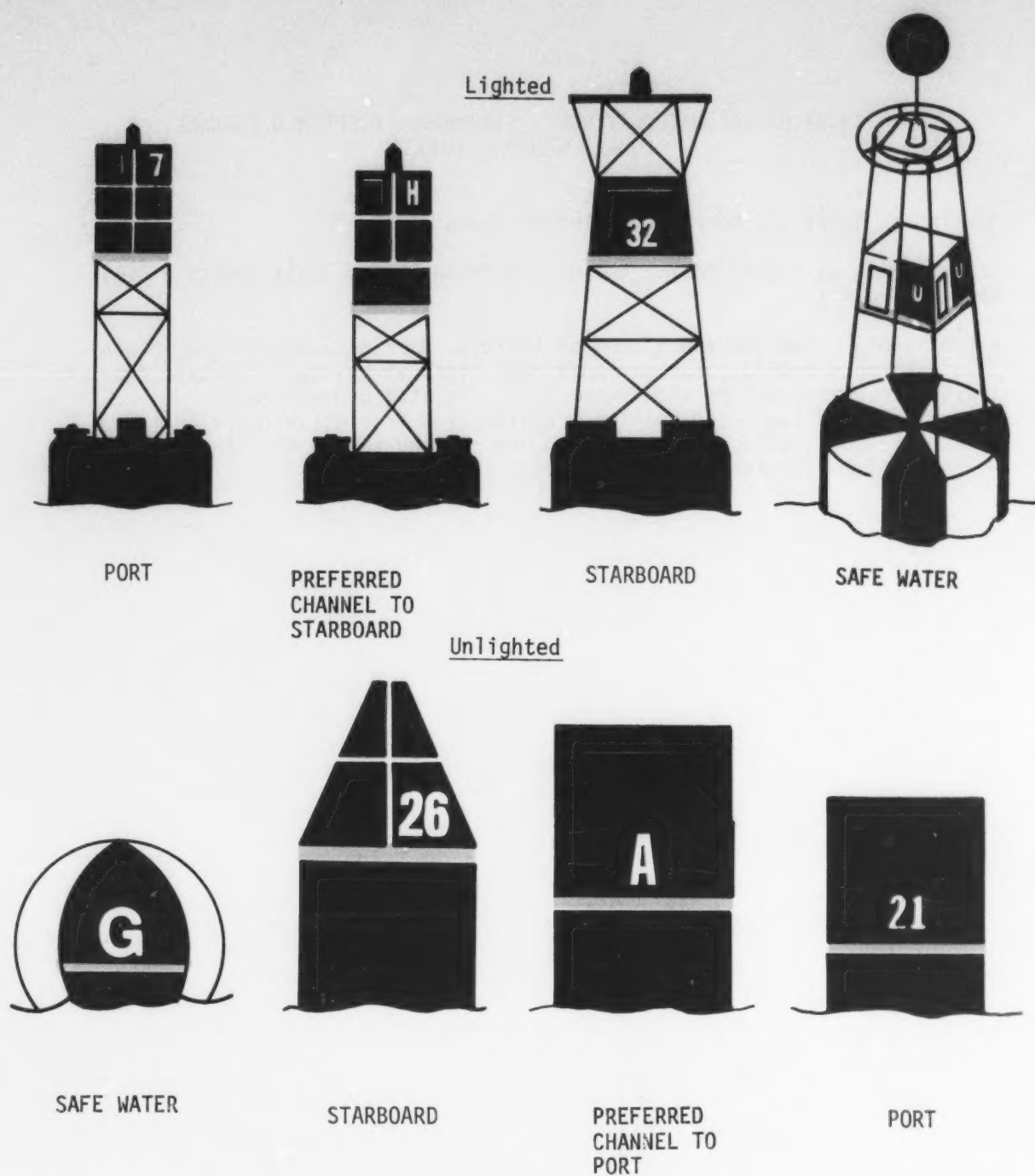


Figure 3-7. Intracoastal waterway port, starboard, preferred channel and safewater marks.

SPECIAL AID MARKS

Radar Reflector Type:

Color. Yellow Munsell chip number 2.5Y8/12.

Characters. Largest, black nonretroreflective LETTER, (Federal color no. 27038) not to exceed 16 in., that will fit in the available area without crowding. Located offset to the right, on the righthand radar reflector. Multiple characters are displayed horizontally (side by side). Mount the black letter on a yellow retro panel.

Retro Panels. Yellow panels, one on each left-hand radar reflector, height to fit in area of reflector and minimum width of 6 in.

Nonradar Reflector Type:

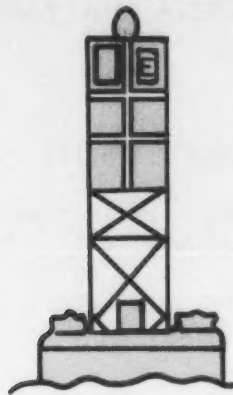
Color. Same as for Radar Reflector Type.

Characters. Largest, black nonretroreflective LETTER, not to exceed 16 in. or one-quarter of the buoy freeboard, that will fit without crowding. For buoys with daymark plates, install the letters to the right of or under the retro panels. For buoys without daymark plates, install 3 letters spaced 120° apart. Mount the letters on yellow retro panels.

Retro Panels. Yellow panels, one sized to fit each daymark plate, with a minimum width of 6 in. or three panels spaced 120° apart, with a height of 6 in. and a width of two-thirds of the buoy diameter at the point of attachment.

Note: Plastic radar reflecting buoys shall be marked like metal nonradar reflecting buoys because they both have similar shapes.

Lighted



Unlighted

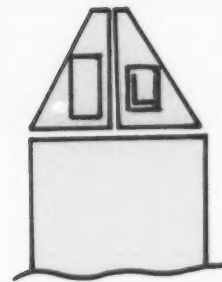
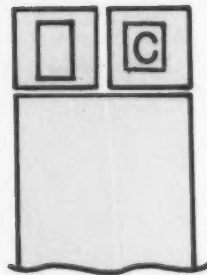


Figure 3-8. Special Aid Marks

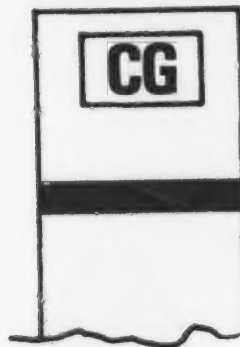
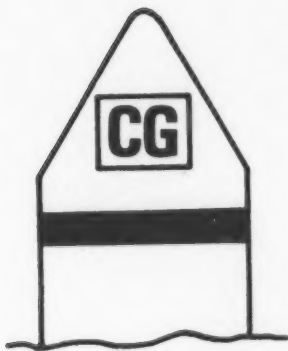
COAST GUARD MOORING BUOYS

Color. White with a blue band (Federal Color Nos. 27875 and 15182).

Appearance. The buoy body shall be white with a narrow blue band located midway between the buoy top and the waterline.

Characters. The buoy shall display three sets of black nonreflective, "CG" characters, sized to fit onto the white retroreflective panels. Multiple characters are displayed horizontally (side by side).

Retro Panels. Three white panels spaced 120° apart, with a minimum height of 6 in. and a minimum width of two-thirds of the buoy diameter at the point of attachment.



WESTERN RIVERS LEFT DESCENDING BANK MARKS

Radar Reflector Type:

Color. Solid red (Munsell chip 7.5R4/16).

Characters. No LETTERS or NUMERALS shall be used.

Retro Panels. Red panels, one on each left-hand radar reflector vane; height to fit in available area and width up to 12 in.

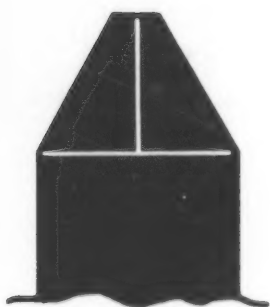
Nonradar Reflector Type:

Color. Same as for Radar Reflector Type.

Characters. Same as for Radar Reflector Type.

Retro Panels. Three red panels spaced 120° apart, with a minimum height of 6 in. and a width of two-thirds of the buoy diameter at the point of attachment.

Note: Plastic radar reflecting buoys shall be marked like metal nonradar reflecting buoys because they both have similar shapes.



WESTERN RIVERS RIGHT DESCENDING BANK MARKS

Radar Reflector Type:

Color. Green (Munsell chip 2.5G5/12).

Characters. No LETTERS or NUMERALS shall be used.

Retro Panels. Green panels, one on each left-hand radar reflector vane; height to fit in available area and width up to 12 in.

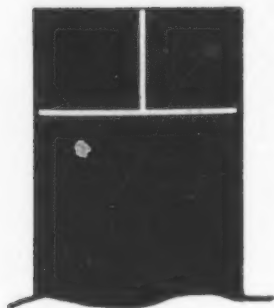
Nonradar Reflector Type:

Color. Same as for Radar Reflector Type.

Characters. Same as for Radar Reflector Type.

Retro Panels. Three green panels spaced 120° apart, with a minimum height of 6 in. and a width of two-thirds of the buoy diameter at the point of attachment.

Note: Plastic radar reflecting buoys shall be marked like metal nonradar reflecting buoys because they both have similar shapes.



WESTERN RIVERS PREFERRED CHANNEL MARKS

Radar Reflector Type:

Color. Red and green horizontal bands (Munsell chips 7.5R4/16 and 2.5G5/12.)

Characters. No LETTERS or NUMERALS shall be used.

Retro Panels. Red or green panels to match top band color, one on each left-hand radar reflector vane; height to fit in available area and width up to 12 in.

Nonradar Reflector Type:

Color. Same as for Radar Reflector Type.

Characters. Same as for Radar Reflector Type.

Retro Panels. Three red or green panels to match top band color located on top band spaced 120° apart, with a height of 6 in. and a width of two-thirds of the buoy diameter at the point of attachment.

Note: Plastic radar reflecting buoys shall be marked like metal nonradar reflecting buoys because they both have similar shapes.



PREFERRED
CHANNEL TO
STARBOARD



PREFERRED
CHANNEL TO
PORT



PREFERRED
CHANNEL TO
STARBOARD



PREFERRED
CHANNEL TO
PORT

TEMPORARY MARKS

Markings: The purpose of a temporary mark is to provide an interim mark when an operational aid is damaged, missing, or unrepairable. It shall have the same markings as the operational aid that it replaces.



Lighted Nun Buoy



Unlighted Can Buoy

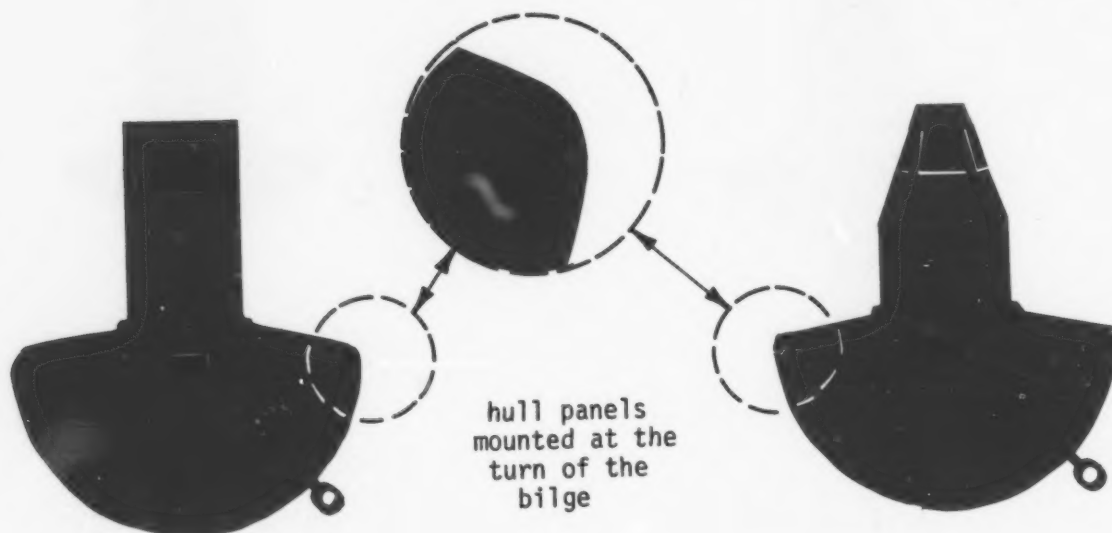
WESTERN RIVERS FAST WATER PORT AND STARBOARD MARKS

Color. Solid green or solid red (Munsell chips 2.5G5/12 and 7.5R4/16) for port or starboard markers, respectively.

Characters. No LETTERS or NUMERALS shall be used.

Retro Panels. Four green (port) or red (starboard) panels mounted on each daymark, spaced 90° apart, with a minimum height of 6 in. and a width equal to one-half of the buoy diameter at the point of attachment. To provide for the possible loss of a daymark, four additional strips, 3 in. by 6 in., of the same color as the daymark panels, shall be mounted on the hull directly below the daymark panels.

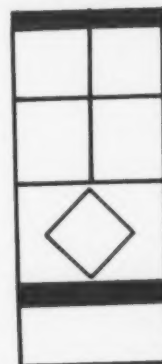
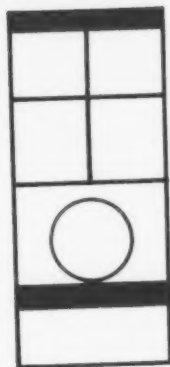
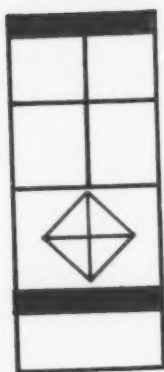
Note: Occasionally, fast water buoys may be used in places other than the western river system. In these cases, the buoys shall also include the appropriate number for port or starboard buoys. The numeral shall be the largest odd or even white retroreflective numeral, not to exceed 16 in., that will fit in the available area below the topmost retro panels without crowding.



INFORMATION AND REGULATORY MARKS

Markings: The vast majority of these marks are can buoys. They shall be white (Federal color number 27875) with orange (Federal color number 12197) retroreflective bands and buoy warning symbols. The warning symbols shall be placed 180° apart. An open diamond indicates a "Danger" area. A cross centered in the diamond shape indicates an "Exclusion" area. An open circle indicates a "Controlled" area. Typical information and regulatory marks are pictured below.

Occasionally, there may be a need to light an information and regulatory mark. If lighted, the mark shall display a white light. The mark shall have three horizontal bands. Except for the color, the bands are identical to the bands for the lighted lateral preferred channel marks picture on page 3-9. The top and bottom bands shall be white. The center band shall be orange. If practical, the warning symbols shall be placed on each right-hand radar reflector.



CHAPTER 4 STRUCTURES

Aids to navigation structures are built in a variety of configurations according to geological and environmental conditions found in each district. Structures support visual and audible navigational equipment in a fixed location and at a design elevation that establishes the geographical range of the navigational aid.

A structure is classified as either a lighthouse or a beacon. A lighthouse structure is an enclosed edifice which houses, protects, displays, or supports visual, audible, or radio aids to navigation. A lighthouse structure is complex in design and construction and usually requires a significant amount of individual engineering site analysis. It can be manned or unmanned and is usually made of granite, brick, cast iron plate, monolithic stone, concrete, or steel. The structure can be located in an offshore, wave-swept, exposed environment, on a coastline as a landfall object, or at any location where a large support structure is required.

Information on the management, design, construction, and maintenance of lighthouse structures is contained in the *Civil Engineering Manual* (CG-251). The automation and preservation

of lighthouse structures are described in *Automation Technical Guidelines* (CG-250-41 Series).

A beacon structure is a support platform for visual and/or audible aids to navigation. It can be either lighted or unlighted. The same type of structure or a similar type is built repetitively and only minimal engineering analysis of individual site locations is required. A beacon structure is relatively simple in design and construction and is usually made of wood, concrete, or steel. Drawings of typical beacon structures are found in *Current Coast Guard Beacon Structures* (CG-250-43). The shape of the beacon structure normally has no significance for signal purposes.

Daymarks are the daytime identifiers of lighted or unlighted beacon structures and appear in any of several colors and shapes, such as square, triangular, or rectangular. Chapter 5 of this volume provides more information on daymarks.

The design of ranges is discussed in detail in *Range Design* (CG-250-39 Series).

A. SELECTION GUIDE

Design Overview. The objective of this section is to highlight important considerations in structural design--not to focus on universally applicable formulas for such design. Structural design by its very nature must be handled on a local basis to ensure that the structure economically meets the requirements of the individual site. This section also deals with the selection of pile structures which are normally built by construction tenders (WLIC) rather than under commercial contract.

In order to design the structure, a basic approach must consider all factors that will impact on the final design. Primary areas which must be considered include the required payload, environmental factors, operational requirements, availability and maintainability of materials, methods available for construction, and other economic considerations. The following paragraphs give a brief overview of each of these areas.

Payload Requirements. The vertical dead load (batteries, visual and audible equipment) and live load (servicing personnel) shall be considered in the design of the structure.

Environmental Factors. Weather, site location, collision, and ice are factors related to the environment which need to be considered.

•Weather. Structures shall be designed to resist those wind, wave, and current forces that occur in a design storm for the specific area. Unless there are overriding considerations, such as a high rate of collision damage, beacon structures shall be designed to resist the 10-yr storm and lighthouse structures shall be designed to resist the 50-yr storm. If design storm data are not available for the area under consideration, the designer must resort to the best available local knowledge (CO/OINC's of tenders, pilots, fishermen, etc.).

•Site location. The individual site location dictates the depth of water and the bottom conditions. Water depth has a direct effect on wave and current forces, while subgrade type (rock, coral, gravel, sand, clay, or silt) has a significant influence on stability of the structure.

•Collision. In high destruction areas, the structure shall be designed to be either "sacrificial" or collision resistant, depending on the type of traffic, the knockdown rate, and the modes of failure.

•Ice. If ice conditions at the design location are severe enough to destroy commonly used structures and occur more frequently than the design storm, then one of the following is applicable: (1) the structure must be considered sacrificial under ice conditions, (2) a buoy should be used instead of a structure, or (3) the structure must be specially designed to resist the expected flow and thickness of ice. The decision will depend on tradeoffs between operational requirements and economic limitations, such as time and cost to replace damaged structures, cost of ice-resistant structures, and ability and acceptability of temporarily replacing damaged structures with buoys.

Operational Requirements. The height of a minor aid structure is one of the most important factors in its design. It affects the distance at which the aids may be seen due to the curvature of the earth (geographic range), the cost of construction, and the contrast of the aid with the background. Excluding ranges, beacon structures with operational requirements for visibility of 3 mi or less in daytime and 8 mi or less at night shall be built with the bottom of the dayboards 7 ft above mean high water. This gives a focal plane height of 11-12 ft with 1-mi dayboards and a height about 1 ft higher with 2-mi dayboards. Lights with

Design Overview (cont'd)

3-mi dayboards will have a focal plane height of 14-16 ft. The purpose of these requirements is to achieve the optimum visibility of the aid.

At the discretion of the District Commander, specific aids may be raised higher than this 7-ft standard if the expected wave height in a certain location exceeds 7 ft or if other objects, such as vegetation, would obscure the aid at this height.

The lantern shall be mounted directly above the dayboards. Where feasible, the daymark shall be the dominant component of the silhouette, with the battery box hidden behind it.

Material Availability. Wood piles are normally the most available type of piling in the continental United States. Depending on the part of the country, douglas fir or southern pine may be most readily available and either type is acceptable.

The availability of steel fluctuates with the national economy and the geographic area.

Concrete piles shall be used only as a last resort when wood or steel piles are not available at a reasonable cost.

Construction Methods

•Construction Trade Skills. Coast Guard construction tenders typically have the equipment and skills necessary to drive vertical and battered piles made of wood, steel, or concrete. The authorized billet structure does not include highly qualified welders (or other metalworker trades) and, for this reason, WLICs are usually limited to fabrication of wood structures onsite or assembly of prefabricated metal structures. These considerations usually limit WLIC construction of multiple pile structures to wood dolphins (three to seven piles driven vertically or on a shallow angle and pulled together at the top with bolts and wire rope) and

four-pile wood platforms. More complex construction is usually accomplished under contract. If performed by Coast Guard construction tenders, special training, special tools, and onsite engineering supervision may be required.

•Limitations. Any floating construction rig is limited in the length of piles that it can handle because of one or more of the following: length of the barge, vertical reach of the boom, depth of water in which the pile is to be driven (generally a maximum of 20 ft for CG tenders), and strength of the pile--to withstand its own dead load (concrete piles). Normally, a 60-ft pile is the maximum length which can be driven in the water depths in which Coast Guard construction tenders build aids.

Economic Factors. Structures shall be designed so as to meet the minimum operational and aesthetic requirements and to minimize the present value of all life-cycle costs associated with building and maintenance. A discount rate of 10 percent shall be used for all expected future costs and benefits, in accordance with the *Civil Engineering Manual* (CG-251) and DOT Order 5000.1 Series, Discount Rates to be Used, in Evaluating Time-Distributed Costs and Benefits.

Structural Theory.

Piles. The piles used for beacon structures are usually friction piles. A friction pile functions as a load transfer unit, distributing the imposed loads to the soil in which it is embedded. The rate of transfer of the load is affected by many factors, such as variations in the strength characteristics of the soil through which the pile must pass and variations in the ability of the soil to accept the load from the pile. The load is transferred from the pile face to the soil by friction, bond, or shear. Therefore, the engineer must have an adequate knowledge of the soil conditions at the proposed site.

Structural Theory (cont'd)

A single pile is analyzed as a cantilever beam mounted in a plasto-elastic medium. Failure of a pile structure can be either of a soil or structural mode. Soil failure takes place when the soil is not strong enough to give fixity to the pile and, thus, the pile remains sound, but the soil ruptures. When the soil is strong enough to give the pile fixity, overloading of the pile will cause structural failure, such as bending, buckling, or cracking.

Soils. All soils have a certain degree of resistance to lateral movement, commonly known as the horizontal subgrade reaction. The degree of this reaction is a function of the soil. When a pile in a cohesive soil is pushed out of its original position, the resisting force on the pile is caused by both the resistance to shear of the soil and the suction created where the pile has been. It is this combination of forces that constitutes the horizontal subgrade modulus (HSM). In non-cohesive soils, the HSM is made up of the shear strength alone. Excluding rock, which is normally incompatible with pile-driving operations, bottom conditions can be categorized into four groups with their respective HSM values, as shown in Table 4-1.

Table 4-1
Bottom Conditions and
Corresponding HSM Values

Type of Soil	HSM
Coral	100
Gravel/dense sand	40
Loose sand/soft clay	5
Fibrous peat/silt	1

Design Example. The design example provided herein (pages 4-6) is a sample only and is not universally applicable.

Preliminary Data and Calculations

•Forces. In most single pile beacon structures, vertical forces tending to

compress the pile are relatively small enough that they can generally be ignored. Table 4-2 displays the moments that would be produced by a 100-mi/hr wind and a 3-kn current on a typical single-pile lighted structure, with a 16-ft focal plane and 3-mi dayboards in the maximum practical depth of water (20 ft). The critical force is the moment developed in the pile at the point where it is essentially fixed in the soil--somewhere below the mudline. A factor of 1.3 times the moment at the mudline is used to develop the maximum moment for this example. The exact factor for any given situation would be a function of the soil. Four cases are given in Table 4-2: 12-in. circular, 18-in. circular, 14-in. octagonal, and 12-in. steel "H" piles. The 12-in. "H" piles have a much higher drag coefficient.

•Moments. The maximum allowable bending moments and common properties of the piles typically used in aids to navigation construction are shown in Table 4-3. Comparison of the maximum *expected* moment (Table 4-2) and the maximum *allowable* moment (Table 4-3) reveals that the strength of most of the commonly used piles exceeds the design load shown in Table 4-2, except for concrete piles and "H" piles.

Structural Analysis. The soil-pile stiffness factor, T , is the fifth root of the pile's "E" and "I" values divided by the soil's HSM value

$$T = \sqrt[5]{\frac{EI}{HSM}} \quad \text{Eq (1)}$$

The ratio of the pile's embedment, L , to T is the maximum depth coefficient, $Z_{\max}$, which is the controlling factor of a pile's fixity

$$Z_{\max} = \frac{L}{T} \quad \text{Eq (2)}$$

It has been empirically determined that fixity occurs when $Z_{\max}$ is equal to or greater than 4.0. Due to the critical

Table 4-2
Commonly Occurring Design Forces and Moments

	<u>Description</u>	<u>Moment at Mudline (ft-lb)</u>	<u>Maximum Moment (ft-lb)</u>
Case 1	12-in. diameter circular cross section (e.g., wood or steel pipe)	37,945	49,328
Case 2	18-in. diameter circular cross section (e.g., steel pipe)	40,759	52,987
Case 3	14-in. octagonal cross section (e.g., concrete)	44,256	57,533
Case 4	12-in. "H" cross section (e.g., steel "H")	53,216	69,180

Notes: Wind = 100 mi/hr (6-ft square, green dayboards [6SG]); wave = 4-ft height; current = 3 kn; depth = 20 ft; factor to develop maximum moment below mudline = 1.3.

Table 4-3
Properties of Pile Types

<u>Type</u>	<u>σ (lb/in.²)</u>	<u>E (lb/in.²)</u>	<u>I (in.⁴)</u>	<u>Allowable Moment (ft-lb)</u>	<u>Weight (lb/ linear ft)</u>
12-in. circular wood	8.1X10 ³	1.76X10 ⁶	1,018	114,512	30
12-in. diameter circular steel	36X10 ³	29X10 ⁶	279	152,615	42
18-in. diameter circular steel	36X10 ³	29X10 ⁶	807	323,567	71
14-in. octagonal concrete	2X10 ³	2X10 ⁶	2,103	50,000	169
12H53 steel	36X10 ³	29X10 ⁶	127*	63,500*	53

*Weak axis.

Notes: σ = stress; E = modulus of elasticity; I = moment of inertia.

Design Example (cont'd)

nature of lighted beacon structures, it is unacceptable to have them leaning as a result of environmental forces. It is, therefore, essential to achieve soil fixity.

For a given soil, fixity can only be improved by increasing the penetration. A stiffer pile will only reduce the structure's flexibility which is usually not a problem. Figure 4-1 displays the soil penetration (in various types of subgrade) that would be required of each type of pile to achieve fixity and, thus, develop its full strength. Because soil is a plasto-elastic medium, if fixity is not achieved, the structure will fail due to movement of the soil before the pile approaches its structural limit.

•Example. To read Figure 4-1 and determine the minimum depth of embedment for a specific case, two items must be known. First, the general type of bottom must be determined for the specific location. Then knowing the type of pile which is to be used, you read down from the base of the arrow for that pile, as indicated by the dotted lines. As shown in Figure 4-1 for a 12H53 pile in coral bottom, you must have at least 11 feet of penetration to achieve fixity. For a standard 12 inch nominal diameter wood pile in a soft clay/loose sand bottom, a penetration of at least 17 ft must be achieved.

Structure Selection

Single Pile. A single-pile structure should normally be constructed if the minimum penetration required to achieve fixity can be attained. Since strength of the pile is not generally the critical factor, the type of pile should be selected on the basis of which has the lowest life-cycle cost. In most locations, the resultant choice will be a wood pile. Figure 4-1 shows that a stronger pile should be used only when the required penetration to develop its full strength can be achieved. For moderate ice conditions or very hard

bottom conditions (HSM = 100), single-pile steel structures are very effective.

Concrete piles are generally not recommended unless it is determined that a wood pile would not penetrate the specific bottom conditions or that steel is too costly and not easily obtainable. The disadvantages listed on Data Sheet 4-D(3) outweigh the few advantages.

Multiple Pile. When the penetration required for fixity cannot be achieved due to tender or other limitations, it becomes necessary to use a multiple-pile structure. Additionally, there may be situations where a three-pile wood dolphin has a lower life-cycle cost than a single-pile steel structure. When the payload requirements for a specific beacon structure include the use of a sound signal, a multiple-pile structure shall normally be constructed to ensure having a structure which is more free from significant vibrations.

•Dolphin. Two basic types of dolphins are constructed by the Coast Guard--battered pile and cluster pile. A battered pile dolphin, which is very effective in soft bottom conditions, consists of three or more piles which are driven on a batter (on an angle to the vertical). This is done in a symmetrical pattern with the piles spread at the bottom and bound together at the top with wire rope or securely fastened with bolts and shear connectors (timber grids) to make as rigid a joint as possible. Because the piles are battered and working with each other, the penetration required for each pile in this type of dolphin is normally two-thirds that required of a single pile in a soft bottom (HSM = 1 to 5). This type of dolphin usually fails when one of the piles breaks due to excessive moment.

A cluster pile dolphin consists of three or more piles all driven vertically, with their surfaces in contact with one another and wrapped tightly together at various heights. The result will be a cantilever action with a bundle of

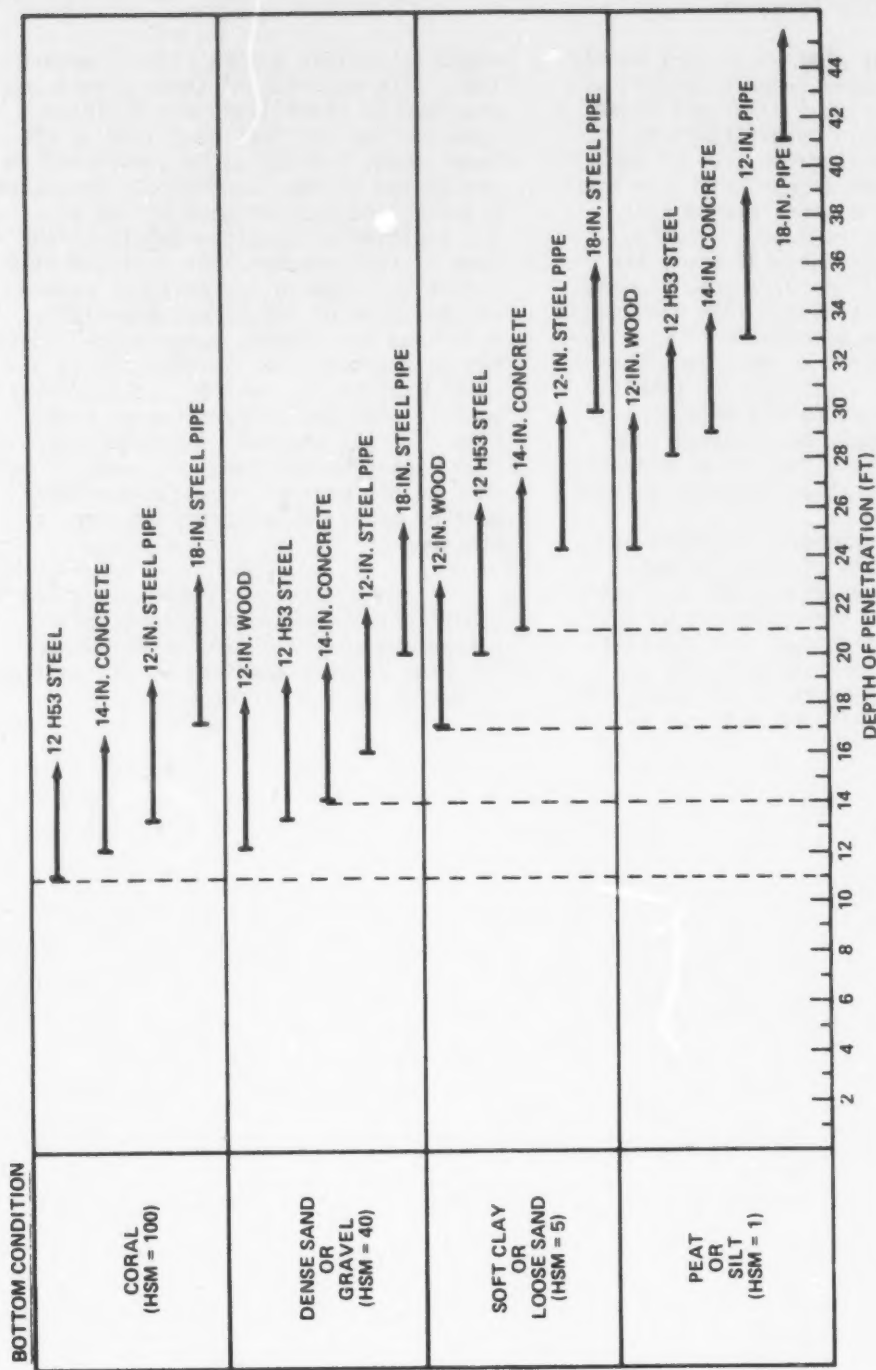


Figure 4-1. Soil-pile selection guide for single pile structures (minimum embedment (ft) to achieve fixity required for maximum pile strength).

Structure Selection (cont'd)

vertical elements that would work mainly in bending. Because shear transfer between the individual piles all along their lengths would be difficult to achieve, the structural action of such a dolphin would be essentially like the action of a single cantilevered pile multiplied by n , the number of piles. All piles would essentially carry the same load and fail simultaneously. However, the penetration required for each pile in this type of dolphin is normally 25 percent greater than that required of a single pile in a soft bottom (HSM = 1 to 5). When considering this type of structure, it should be compared to a single steel pile--with special attention to strength, weight, and bearing surface.

•Platform Structure. This type of foundation consists of three or more separate pilings which are driven vertically. The piles are connected by a pile cap (i.e., platform) that spreads the vertical and horizontal loads and any overturning moments to all the piles in the group. Cross bracings can be

added to achieve a more rigid foundation. The majority of these structures are used as foundations for skeleton towers. The vertical dead load of the tower must, therefore, be considered in the design of the foundation. The penetration required for each of the piles for a platform structure should be the same as that required for a single-pile structure. Due to the critical nature of this type of structure, especially when used for ranges, penetration should not be reduced. The lateral spread between each of the vertical pilings must be less than the penetration of each pile. If the minimum required penetration cannot be achieved, at least 75 percent of the minimum required embedment must be achieved and cross bracing is required.

Other Conditions. When heavy ice conditions are prevalent, caissons or riprap are commonly used to withstand the high dynamic loadings which ice flows impose on marine structures.

B. PREPARATION AND INSTALLATION

Foundations

Piling

•Preparation

1. Wood. Wood pilings shall be treated in accordance with section 4.2.2 of the *Coatings and Color Manual* (CG-263).

Preservation of wood piles is necessary so that the "extended" natural life of the pile matches the design life of the structure. If it can be accurately predicted that a specific structure will be destroyed by collision within a 6-mo period, untreated piles are recommended.

2. Steel. The life of steel piles in water can be extended if the piles are a corrosion-resistant grade of steel--if not, protection is required as outlined in section 4.2.3 of CG-263.

3. Concrete. No preparation is necessary for concrete piles.

•Installation Methods

1. Driving. Piles are usually embedded with a steady succession of blows on the top of the pile. The blows can normally be applied by using a drop, air, steam, or diesel hammer. For those locations with soft bottom conditions (fibrous peat or silt), the dead weight of the hammer is usually sufficient to embed the pile to almost the minimum penetration required.

a. Wood. When driving a wood pile, especially into a hard bottom (sand or gravel), careful watch should be made for any temporary pauses in the smooth embedment of the pile. A pause could be the result of hitting a boulder and continued driving would broom or splinter the pile, as shown in Figure 4-2. For very hard driving, steel toe shoes can be used to protect the tip of the pile.

b. Steel. Steel piling is capable of withstanding hard driving. If problems are incurred, a pointed steel toe

can be attached and will aid in penetrating very hard bottoms (limestone shale or hard coral). Because of the difficulty of cutting off excess steel piling, it should be driven to the required height above water, even though it may be deeper than required to achieve fixity.

c. Concrete. Concrete piling is very fragile and requires careful handling. The piling shall be picked up only with the lifting eyes which are provided. Storage of concrete piles shall be accomplished by placing the chocking directly below the lifting eyes and then stacking.

The concrete pile must be driven straight. Any eccentricity (driving off center) will cause cracking of the pile. Cracking is then likely to accelerate corrosion of the prestressed reinforcement and thereby severely shorten the life of the pile. Because of the difficulty in cutting off excess concrete piling, it should be driven to the required height even though it may be deeper than required to achieve fixity.

2. Jetting. Another method of embedding a pile is by jetting--the displacement of the soil at the pile tip by using a high pressure stream of water and air, as shown in Figure 4-3. As the soil is washed away, the pile sinks under its own weight and that of the hammer, which is resting on it. A few hammer blows are struck to keep the pile moving downward. When it is within a few feet of the desired final position, the jet pipe is withdrawn and the pile is driven the rest of the way with the hammer. The action of a single jet pipe on one side of a pile tends to send it out of plumb; therefore, as the pile is embedded, the jet pipe shall be continuously worked around it to evenly displace the soil.

•Embedment. The minimum required embedment, as indicated in Figure 4-1, or refusal must be achieved to ensure proper structural integrity of the pil-

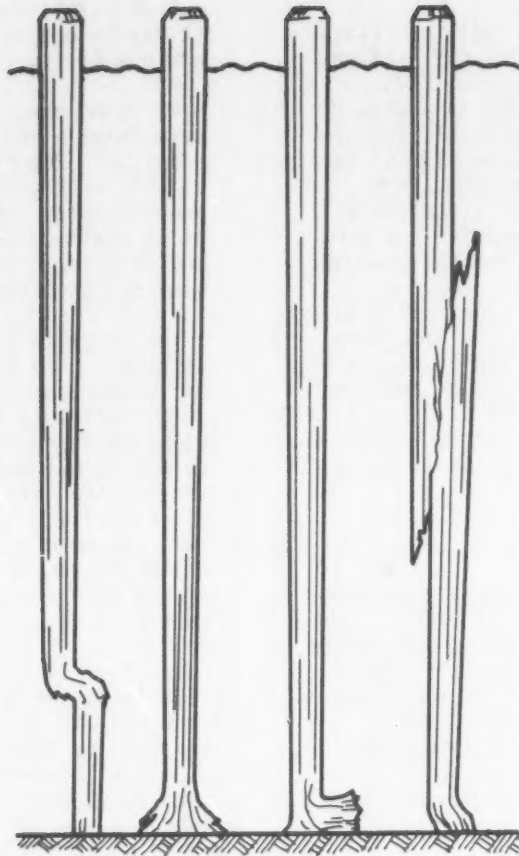


Figure 4-2. Types of pile damage due to overdriving of wood piles.

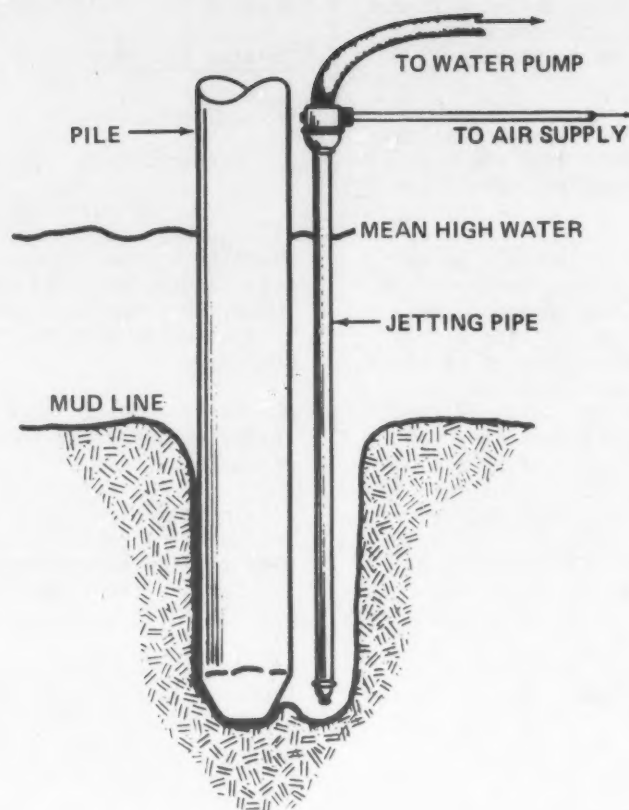


Figure 4-3. Jetting with a single jet pipe.

ing. For those locations with hard bottom conditions (coral or gravel), refusal might be achieved before reaching the depth indicated in Figure 4-1. Refusal is defined as when the last six blows of a drop hammer or the last 20 blows of a diesel, steam, or air hammer will not drive the pile more than an average of 1/8 in. per blow. Allowance should be made for temporary pauses during the driving of the pile--often the result of hitting a boulder. If refusal occurs before reaching the depth indicated in Figure 4-1, an evaluation shall be made as to whether the pile has achieved fixity. If the pile is at least three-quarters embedded to its required minimum (see Figure 4-1) and if a moder-

ate horizontal force can be applied and the pile does not lean, sufficient fixity has probably been achieved. Driving can then be discontinued and the top of the pile cut off at the prescribed height. If it appears that fixity has not been achieved, the pile shall be pulled out and redriven within proximity to its required position.

Other Foundations. The following foundations shall be prepared and installed in accordance with the applicable district (ecv) drawings and specifications: posts, spindles, caissons, concrete footings and slabs, steel stakes, and riprap.

Table 6-2
Selection Guide for Directional Lenses
Using 12 Vdc Incandescent Lamps for Selection of Range Lights
(Lamps rated in amperes)

OPTIC	250 mm with condensing panel					FA 240 (60°)					FA 240 (30°)					FA 240 (3.5° x 2°)				
CHARACTERISTICS	Fl. 2.5 Qr. Fl. 1. (N. Fl.	Fl. 4 Qr. Fl. 1. (N. Fl.	Fl. 6 Qr. Fl. 1. (N. Fl.	Fl. 6 Qr. Fl. 1. (N. Fl.	E. Int. 6 Occ. 4	Fl. 2.5 Qr. Fl. 1. (N. Fl.	Fl. 4 Qr. Fl. 1. (N. Fl.	Fl. 6 Qr. Fl. 1. (N. Fl.	Fl. 6 Qr. Fl. 1. (N. Fl.	E. Int. 6 Occ. 4	Fl. 2.5 Qr. Fl. 1. (N. Fl.	Fl. 4 Qr. Fl. 1. (N. Fl.	Fl. 6 Qr. Fl. 1. (N. Fl.	Fl. 6 Qr. Fl. 1. (N. Fl.	Fl. 4 Qr. Fl. 1. (N. Fl.	Fl. 6 Qr. Fl. 1. (N. Fl.	E. Int. 6 Occ. 4			
NOMINAL RANGE (mm) ON AXIS	25	45	75	125		25	45	75	125		25	45	75	125	25	45				
8	55	95	155	255		55	95	155	255		55	95	155	255	55	95				
9	75	135	225	375		75	135	225	375		75	135	225	375	75	135				
10	115	205	345	575		115	205	345	575		115	205	345	575	115	205				
11	155	275	465	775		155	275	465	775		155	275	465	775	155	275				
12	205	365	615	1035		205	365	615	1035		205	365	615	1035	205	365				
13	255	445	745	1245		255	445	745	1245		255	445	745	1245	255	445				
14	305	535	895	1495		305	535	895	1495		305	535	895	1495	305	535				
15	355	625	1045	1745		355	625	1045	1745		355	625	1045	1745	355	625				
16	405	715	1195	1995		405	715	1195	1995		405	715	1195	1995	405	715				
17	455	805	1345	2245		455	805	1345	2245		455	805	1345	2245	455	805				
18	505	895	1495	2495		505	895	1495	2495		505	895	1495	2495	505	895				

Note: Enter the table with the nominal range and color required for the given application. The horizontal row gives the standard size 12 Vdc lamp (in amperes for use with the CG-181 characteristic heading in each vertical column. Note that the available characteristics are listed for each of the standard optics in the 12 Vdc system. The nominal range given in the equipment sheet for the lantern selected. When more than one optic/lamp combination is available for the desired range and color, the characteristic, off axis nominal range, initial cost and operating cost should be considered. The row labeled CHARACTERISTIC is described in Table 6-1.

Selection of Equipment for a Range. The Range Design Program (CG-250-39) gives the maximum and minimum intensity for the rear (RI) and front (FI) range lights and the intensity ratio (RI/FI). For example:

white lights
 $200 < FI < 650$
 $800 < RI < 1200$
 $1.5 < \frac{RI}{FI} < 2.4$

- Locate acceptable intensities for the front and rear light in the *Equivalent Fixed Intensity on Axis* column in Tables 6-4 and 6-5. For example:

$FI = 470$
 $RI = 865$
 $\frac{RI}{FI} = \frac{865}{470} = 1.8$

- The nominal range on axis is given in the column to the left. The columns to the right give the lamps to be used for each characteristic/lantern combination. The possible combinations for the example are listed below:

front light:

lantern	lamp	characteristic
155	2.03	Occ. 4
	2.03	E. Int. 6
	2.03	Fixed
250 CP	.25	Qk. Fl.
FA 240 (30)	.55	Qk. Fl.
	.25	E. Int. 6
	.25	Occ. 4
	.25	Fixed
FA 240 (8)	.55	Qk. Fl.
	.25	Occ. 4
	.25	E. Int. 6
	.25	Fixed
FA 240 (3)	.25	Qk. Fl.

rear light:

lantern	lamp	characteristic
250 CP	.55	Qk. Fl.
	.25	E. Int. 6
	.25	Occ. 4
	.25	Fixed
FA 240 (30)	.77	Qk. Fl.
	.55	E. Int. 6
	.55	Occ. 4
	.55	Fixed
FA 240 (8)	.25	Qk. Fl.

- The front range light should be Quick Flashed, and the rear range light should be either Occ. 4, E. Int. 6, or Fixed. Barring other operational requirements, initial cost, battery cost and maintenance difficulty are used to make a final selection. The front range light should be a 250-mm lantern equipped with a condensing panel and 0.25 A lamps. The rear range light should be a 250-mm lantern equipped with a condensing panel and 0.25 A lamps.

- The horizontal off-axis intensity of the lantern/lamp combinations are given in Table 6-6. The off-axis intensity may be an operational requirement for some ranges. If the rear and front lights are synchronized on the same characteristic, any flash characteristic may be used.

- In some cases Table 6-4 may not be useful because the maximum and minimum intensities calculated in the Range Design Program do not bracket values shown in the column labeled *Equivalent Fixed Intensity on Axis*. However, the table still indicates which lantern/lamp combinations should be considered. The manual CG-250-12E must be used to make a final selection.

Selection of Equipment for a Range. The Range Design Program (CG-250-39) gives the maximum and minimum intensity for the rear (RI) and front (FI) range lights and the intensity ratio (RI/FI). For example:

white lights
 $200 < FI < 650$
 $800 < RI < 1200$
 $1.5 < \frac{RI}{FI} < 2.4$

- Locate acceptable intensities for the front and rear light in the *Equivalent Fixed Intensity on Axis* column in Tables 6-4 and 6-5. For example:

$FI = 470$
 $RI = 865$
 $\frac{RI}{FI} = \frac{865}{470} = 1.8$

- The nominal range on axis is given in the column to the left. The columns to the right give the lamps to be used for each characteristic/lantern combination. The possible combinations for the example are listed below:

front light:

lantern	lamp	characteristic
155	2.03	Occ. 4
	2.03	E. Int. 6
	2.03	Fixed
250 CP FA 240 (30)	.25	Qk. Fl.
	.55	Qk. Fl.
	.25	E. Int. 6
	.25	Occ. 4
FA 240 (8)	.25	Fixed
	.55	Qk. Fl.
	.25	Occ. 4
	.25	E. Int. 6
FA 240 (3)	.25	Fixed
	.25	Qk. Fl.

rear light:

lantern	lamp	characteristic
250 CP	.55	Qk. Fl.
	.25	E. Int. 6
	.25	Occ. 4
	.25	Fixed
FA 240 (30)	.77	Qk. Fl.
	.55	E. Int. 6
	.55	Occ. 4
	.55	Fixed
FA 240 (8)	.25	Qk. Fl.

- The front range light should be Quick Flashed, and the rear range light should be either Occ. 4, E. Int. 6, or Fixed. Barring other operational requirements, initial cost, battery cost and maintenance difficulty are used to make a final selection. The front range light should be a 250-mm lantern equipped with a condensing panel and 0.25 A lamps. The rear range light should be a 250-mm lantern equipped with a condensing panel and 0.25 A lamps.

- The horizontal off-axis intensity of the lantern/lamp combinations are given in Table 6-6. The off-axis intensity may be an operational requirement for some ranges. If the rear and front lights are synchronized on the same characteristic, any flash characteristic may be used.

- In some cases Table 6-4 may not be useful because the maximum and minimum intensities calculated in the Range Design Program do not bracket values shown in the column labeled *Equivalent Fixed Intensity on Axis*. However, the table still indicates which lantern/lamp combinations should be considered. The manual CG-250-12E must be used to make a final selection.

Table 6-4
Selection Guide for Range Lights That Use 12 Vdc Lamps
(lamps rated in amperes)

OPTIC	155 mm		250 mm		FA 240 (30°)		FA 240 (8°)		FA 240 (3.5° X 2°)	
	NOMINAL RANGE (m)	CHARACTERISTICS	Qk. Fl.	E. Int. 6 Fixed Occ. 4	Qk. Fl.	E. Int. 6 Fixed Occ. 4	Qk. Fl.	E. Int. 6 Fixed Occ. 4	Qk. Fl.	E. Int. 6 Fixed Occ. 4
1	1	NOMINAL RANGE (m) RED OR GREEN								
2	2	NOMINAL RANGE (m) CLEAR								
3	3	EQUIVALENT FIXED INTENSITY ON AXIS (CANDELA)								
4	4									
5	5									
6	6									
7	7									
8	8									
9	9									
10	10									
11	11									
12	12									
13	13									
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92	92									
93	93									
94	94									
95	95									
96	96									
97	97									
98	98									
99	99									
100	100									

Note: Enter the table with the nominal range (peak beam) or the equivalent fixed intensity (peak beam) and color required for the given application. The horizontal row gives the standard 12 Vdc lamp to be used with the characteristic and optic heading in each vertical column.

Use of the 250-mm lantern with a condensing panel will provide a passing light in addition to the directed beam.

The equivalent fixed intensity (peak beam) can be used to estimate the intensity ratio of the rear and front light.

TABLE 6-5
SELECTION GUIDE FOR RANGE LIGHTS THAT USE 120 VAC LAMPS
(LAMPS RATED IN WATTS)

OPTIC			250 MM VENTED	300 M	250 MM WITH C.P. VENTED	DCB-24	
CHARACTERISTICS			OK. FL. E. INT. 8 OCC. 4	OK. FL. E. INT. 8 FIXED OCC. 4	OK. FL. E. INT. 8 OCC. 4	E. INT. 8 OCC. 4	FIXED
NOMINAL RANGE (mm) RED OR GREEN ON AXIS	NOMINAL RANGE (mm) CLEAR ON AXIS	EQUIVALENT FIXED INTENSITY ON AXIS (CANDELA)					
5		522	250				
6	5	750		250			
7	6	1,500	250	250 250			
8	7	1,565	250				
9	8	2,250		250			
10	9	4,500	250	250	250		
11	10	5,400				250	
12	11	12,700					
13	12	18,163			250		
14	13						
15	14	38,105				250	
16	15						
17	16						
18	17	280,000				~~500~~	~~500~~
19	18						
20	19	500,000				1000	1000
21	20						
22	21						
23	22	1,400,000				~~1000~~	~~1000~~
24	23						
24	24	2,500,000				1000	1000

6-15/(6-16 BLANK)
CH-1

B. PREPARATION AND INSTALLATION

Equipment Inspection. All components shall be inspected for damage upon receipt. Make a written record of any damage and notify the supplier, carrier, and other interested parties. Photographs shall be taken of rotating beacons that arrive damaged.

Mechanical Assembly

Lanterns with CG-181 Flasher and CG-6P Lampchanger

•Flasher, Lampchanger, and Mounting Bracket Assembly. In all lanterns except the FA-240 range lantern, the CG-6P lampchanger is mounted on top of the CG-181

flasher with the mounting bracket in between. Four 7/8- or 1-in., 10-32 stainless steel screws are required for this connection. With the FA-240, the lampchanger and the flasher are mounted on separate brackets with four (each) 1/2-in., 10-32 stainless steel screws and nuts. Other requirements peculiar to a given lantern are listed below.

1. 155 mm. The mounting bracket is supplied with the lantern and is secured to the base pot by two 3/16-in., 10-32 stainless steel screws and lockwashers, which are also supplied with the lantern (Figure 6-1).

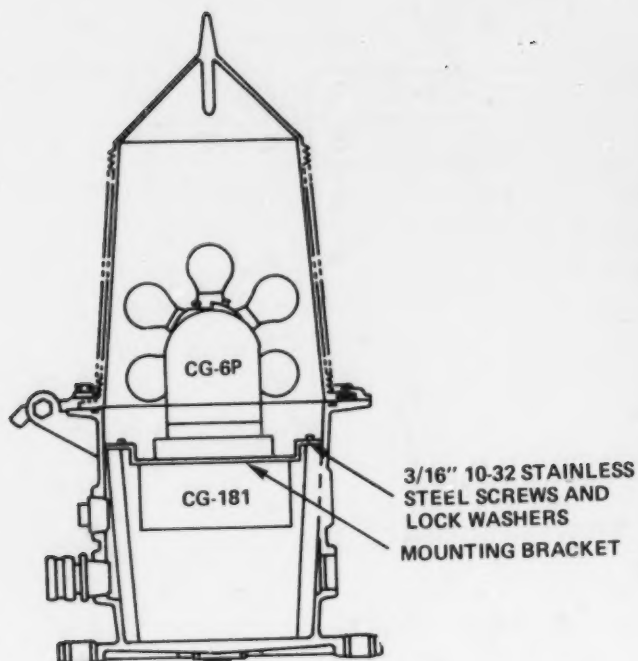
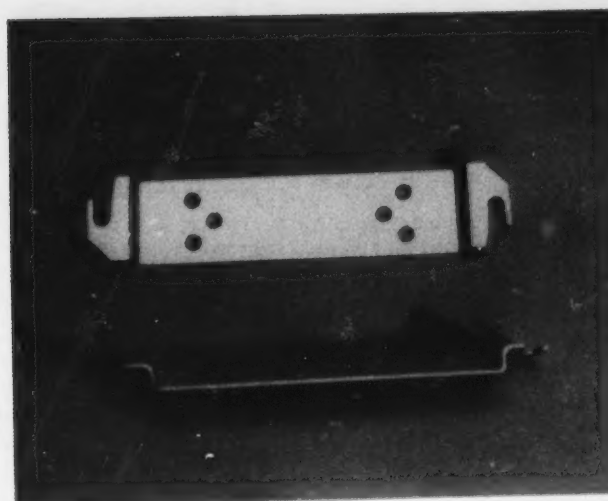


Figure 6-1(a). 155-mm interior assembly.



Note: This bracket provided with lantern.

Figure 6-1(b). 155-mm mounting bracket.

Mechanical Assembly (con't)

2. 200 mm. The mounting bracket must be fabricated locally of aluminum or stainless steel and is secured to the base pot with two 1-in., 1/4-20 NC stainless steel screws and lock nuts (Figure 6-2).

3. 250 mm. The flasher and lampchanger are mounted on the mounting ring supplied with the lantern, as shown in Figure 6-3(a). This adjustable mounting ring is secured to studs on the lens support ring by 3/4-in. spacers and wing nuts, as shown in Figure 6-3(b). Bird guards are permanently mounted as shown in Figure 6-4 and, if required, condensing panels shall be installed in accordance with the standards and instructions in Figure 6-5.

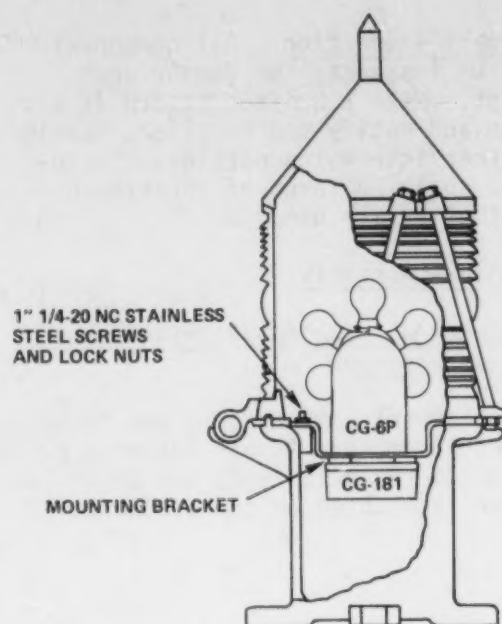
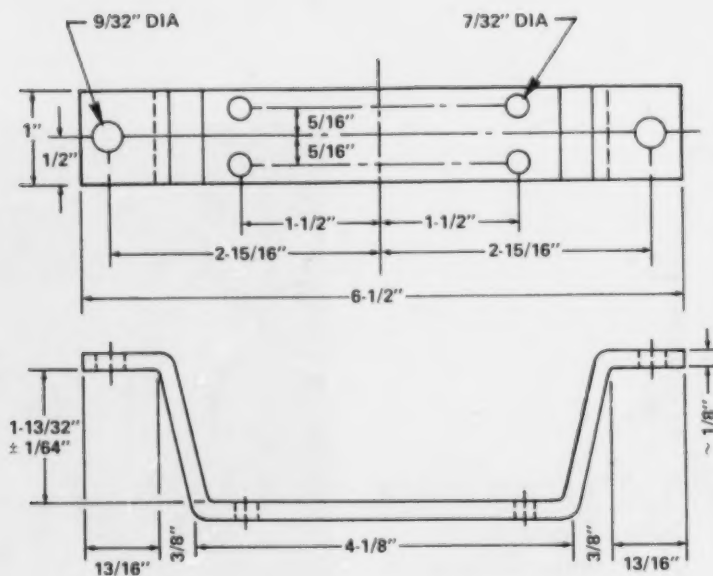


Figure 6-2(a). 200-mm interior assembly.



Note: This bracket is fabricated locally from aluminum or stainless steel to the dimensions above.

Figure 6-2(b). 200-mm mounting bracket.

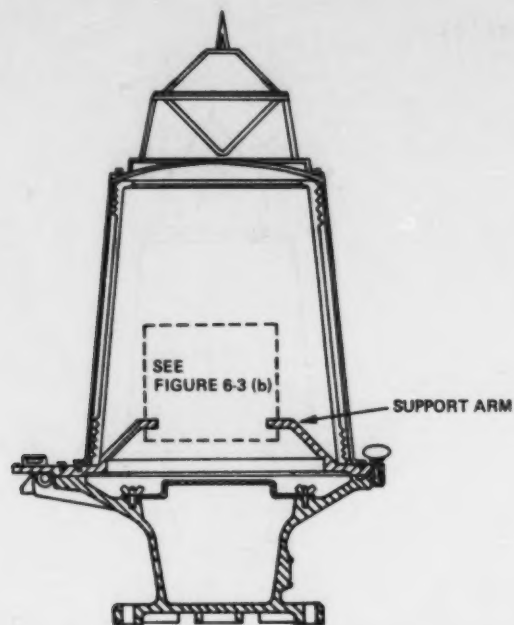


Figure 6-3(a). 250-mm interior assembly.

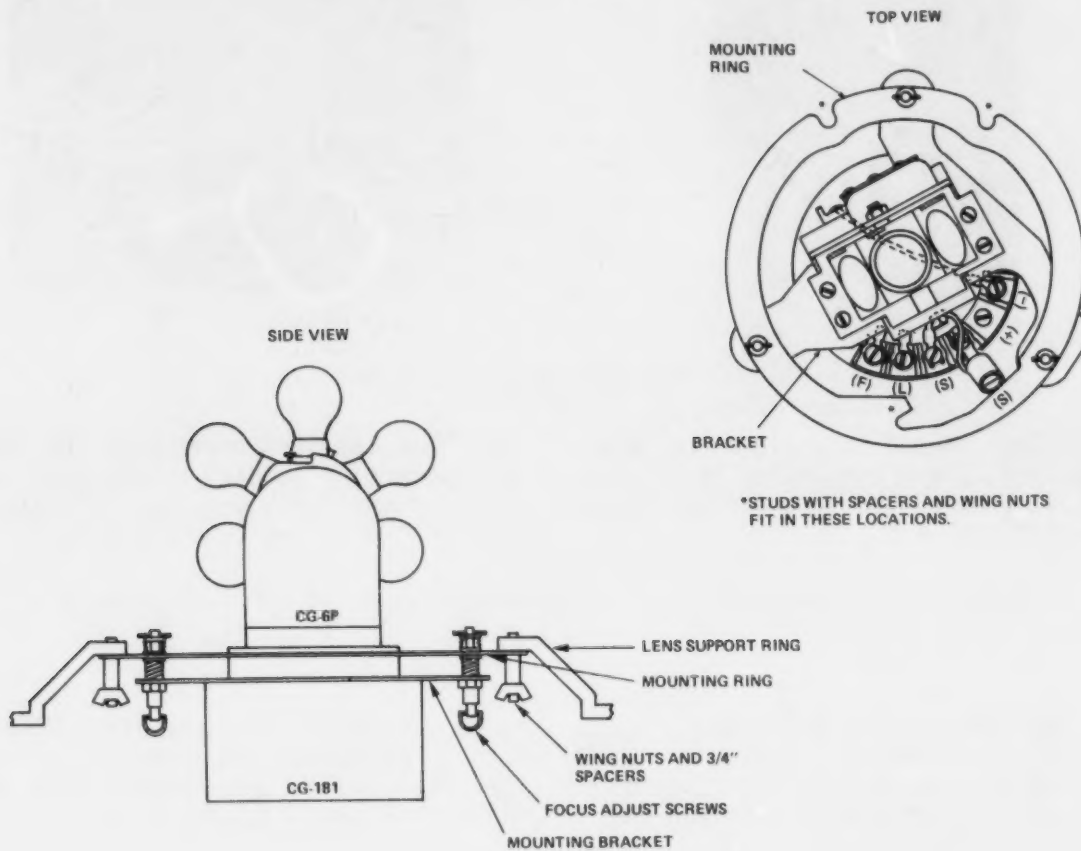


Figure 6-3(b). 250-mm lampchanger support assembly and mounting ring.

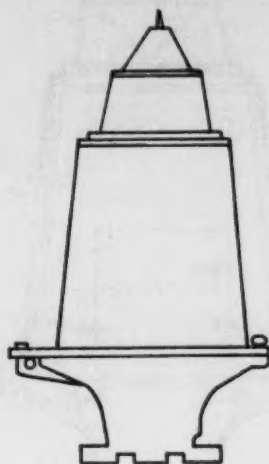
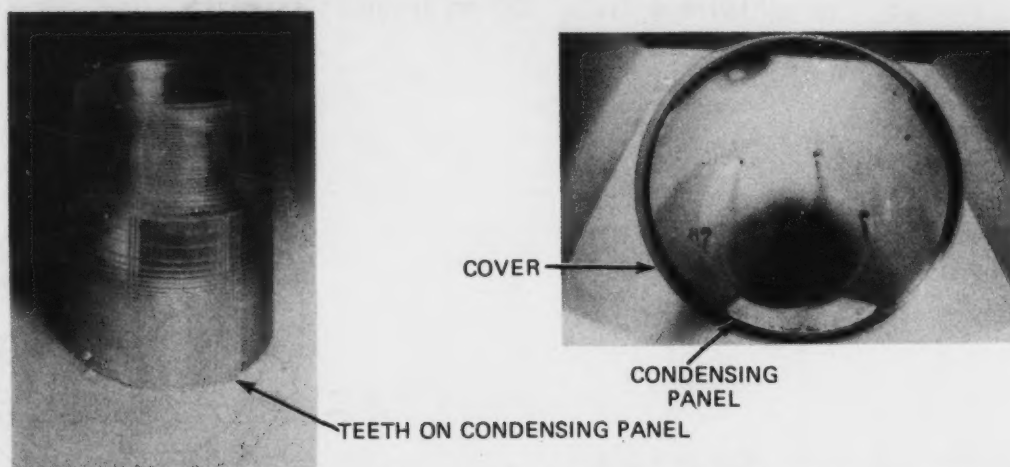


Figure 6-4. Integrated birdguard on a 250-mm lantern.



(a) With lens placed in position on lens support ring, place condensing panel with teeth base down on the lens support ring and against the lens.

(b) Place the lens cover over the lens and condensing panel. Ensure that one of the cover teeth engages the center tooth space of the condensing panel.

Figure 6-5. Installation of a condensing panel in a 250-mm lantern.

4. 300 mm. The flasher and lamp-changer are connected to a bracket (Figure 6-6(d)), which fits onto two studs of the lantern mounting tripod and

is secured with 10-32 stainless steel nuts. The lantern mounting tripod locks into the lantern lens support ring, as shown in Figure 6-6(a) and (c).

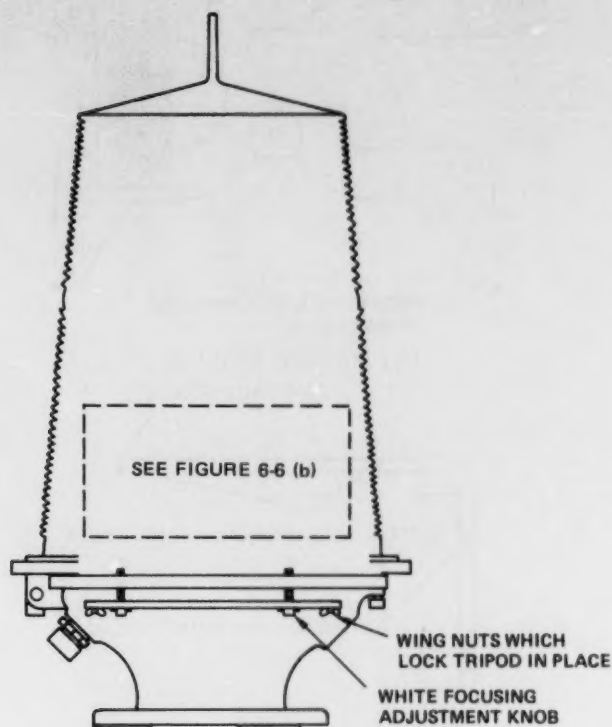


Figure 6-6(a). Typical lantern with CG-181 flasher and CG-6P lampchanger.

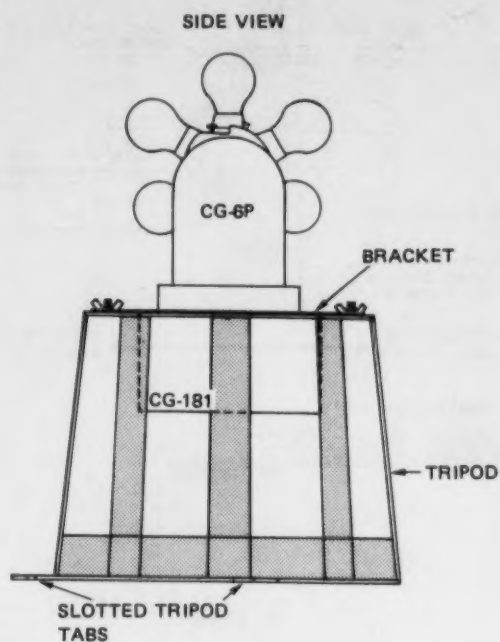


Figure 6-6(b). Interior assembly with tripod locked to the lantern lens support ring and assembled with bracket, CG-6P, and CG-181.

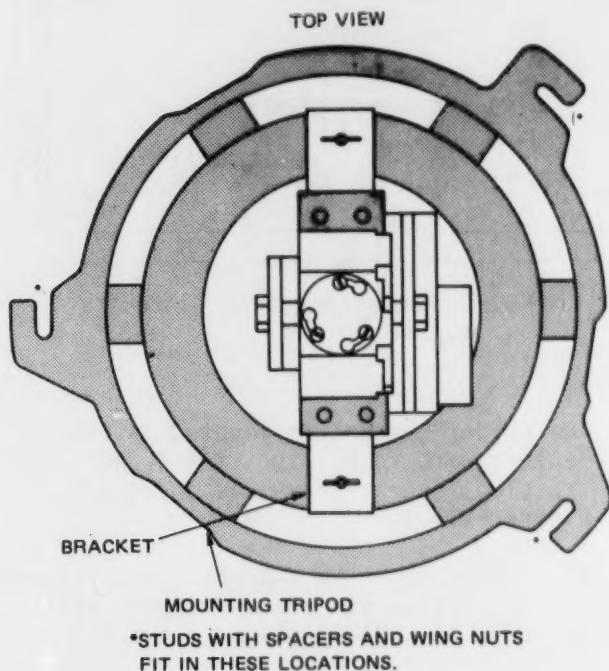


Figure 6-6(c). Tripod locked to studs.

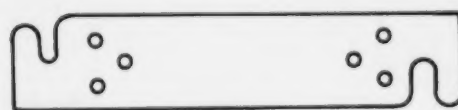
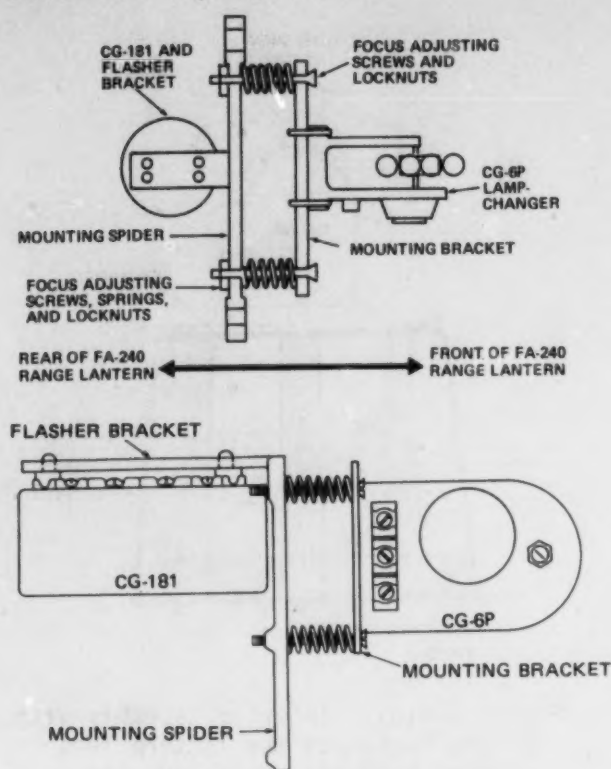
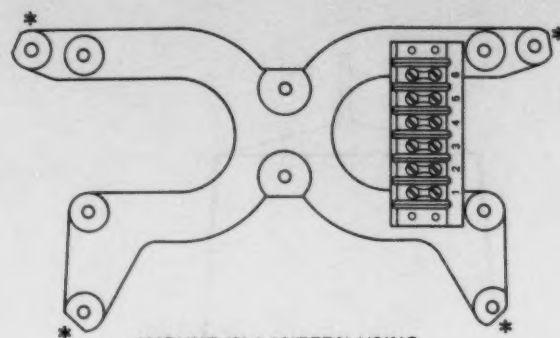


Figure 6-6(d). Support bracket for CG-6P and CG-181.

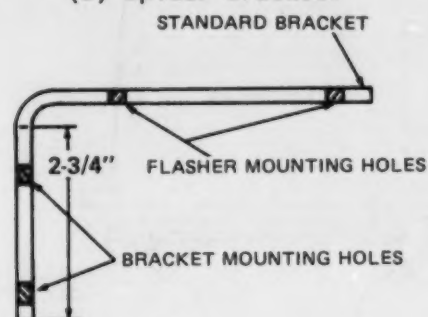
Mechanical Assembly (cont'd)



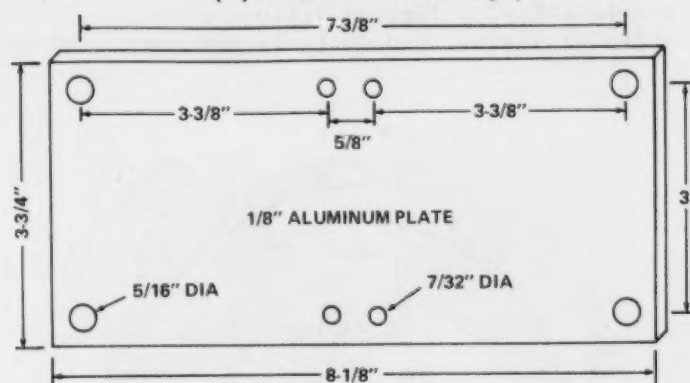
(a) Mounting assembly.



(b) Spider bracket.



(c) Flasher mounting plate.



(d) Lampchanger mounting plate.

Figure 6-7. Mounting the 12 V equipment in an FA-240.

5. FA-240. The flasher and lampchanger are mounted on separate brackets which are in turn mounted on an adjustable spider bracket, as shown in Figure 6-7 (a). The flasher bracket is mounted on the spider bracket with 2-1/2-in., 10-32 stainless steel screws and nuts. The lampchanger mounting bracket is connected to the mounting spider by four focus adjusting screws and lock nuts.

The spider bracket is mounted in the lantern with four 1-in., 1/4-20 NC stainless steel screws, as shown in Figure 6-7(b).

6. 190-mm Rotating Beacon. This lantern is a precision piece of equipment that shall be assembled only by a skilled mechanic in accordance with the manufacturer's instruction manual (Amerace Rotating Beacon Type No. 2130). The

Mechanical Assembly (cont'd)

CG-181 flasher shall be separated from the mounting bracket by 3/4-in. spacers to prevent rubbing between the flasher and the rotating lens ring. Supplementary instructions are listed under the Special Requirements section below.

•Daylight Controls

1. 155-, 200-, 250-, and 300-mm Lanterns. A type L daylight control shall be used when a fixed on characteristic is used. With plastic lanterns, a type C or R photoelectric cell (depending on whether the lens is clear or colored) is mechanically connected by its mounting lug on the CG-181 flasher, as shown in Figure 6-8. Note the tolerances listed on this figure. Care shall be exercised so as not to disturb the preset angle between the case and lug, which gives the photoelectric cell proper exposure to sunlight. Failure to ensure that the angle is within the tolerances may result in improper control of the signal. For the 200-mm lantern, type C or B are used for clear and colored lenses, respectively.

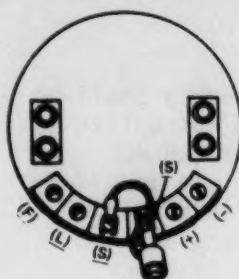
2. FA-240 and 190-mm Rotating Beacon. These lanterns require a type L (exterior plug) photoelectric cell. A pipe plug extension may be necessary to prevent shading and ensure adequate exposure of the photoelectric cell.

•Special Shop Requirements for Mechanical Assembly of the 190-mm Rotating Beacon. The following requirements supplement the manufacturer's instructions:

1. Rolamite Assembly. At the limit of the motor unit's travel away from the drive ring (toward the center of the lantern), there shall be 1/4 to 1/8 in. between the drive wheel and the ring. The motor unit must swing freely and smoothly through its travel, and the motor cable must not restrict or apply any force which would tend to slow or restrict movement of the unit.

2. Spring Assembly. The 190-mm lanterns procured after July 1977 will have a

TOP VIEW



INSTALL CG-234 DAYLIGHT CONTROL ON THE TWO YELLOW (CENTER) TERMINALS.

ENSURE THAT THE DAYLIGHT CONTROL HAS A PRESET ANGLE WITHIN TOLERANCE BEFORE AND AFTER INSTALLATION.

SIDE VIEW



Figure 6-8. Installation of a CG-234 daylight control on a CG-181 flasher.

spring assembly that maintains the tension between the friction drive wheel and the lens ring assembly. The rolamite assembly will not be available after July 1977. The spring assembly has no adjustments. Rolamite assemblies should be converted to spring assemblies when convenient.

3. Rotation Speed. With the lantern leveled and secured, verify that the optic rotates within ± 2 percent of rated rpm at both 10.5 and 13.5 V.

Medium-Sized and Large Rotating Beacons. These beacons are expensive, precision optical devices and shall be assembled only by a skilled mechanic in accordance with the applicable manufacturer's instruction manual.

•FA-251-AC. Assembly is discussed in the manufacturer's manual (Automatic Power FA-251 Rotating Beacon AC).

•DCB-24 and DCB-224. Assembly shall be in accordance with Crouse-Hinds Bulletin A-229-3/61 for optics manufactured by Crouse-Hinds, and with Carlisle and Finch Instruction Book Nos. M24B263 and M24B262, of 1974, for optics manufactured by that company. Supplemental instructions are as follows:

1. Drive Assembly. Verify that the rotational speed is within 3 percent of the rated rpm at nominal voltage.

2. Carlisle and Finch Lampchangers. The 120 Vac, two-place lampchanger supplied with these optics can be modified to include arc suppression and lampchanger mode detection. A modification kit (available from the manufacturer) shall be installed on any unmodified lampchanger (Figure 6-20) which is used in a fixed optic where the light is flashed. Lampchangers used in the DCB-24 and the DCB-224 do not require this modification kit.

3. Gear Box Lubrication. Mobil SHC634 and Winsmith Co. Catalog No. 51-000 are authorized lubricants.

Focusing

General Requirements. Slight vertical or horizontal displacements of the lamp filament center from the true focal point of an optic will affect the projected beam. Depending on the type of optic, these variations will result in displacement of the beam up or down from the intended horizontal, or in a more diffuse, wider beam. To ensure that the optic produces the designed beam profile and provides rated intensity in the plane of the mariner, it is necessary to place the lamp at the focal

Focusing (cont'd)

point of the optic within prescribed tolerances. Specific requirements and tolerances are given below.

Specific Requirements

•155- and 200-mm Lanterns. The lens of each lantern is equipped with four sighting marks. The marks on the 155-mm lens are two adjacent clear circles with two opposite circles engraved with X's. For the 200-mm lens, the sighting marks are four raised ovals. The rear sighting mark on the 200-mm lens is very difficult to see. To improve its visibility, a gummed reinforcement commonly used on loose leaf paper may be temporarily placed around the rear oval. To focus, the lamp filament shall be viewed along perpendicular axes through these pairs of sighting marks (Figure 6-10). The filament location shall be adjusted if it does not meet the criteria shown in Figure 6-11, which depicts the 200-mm sighting marks as they would appear with the gummed reinforcement around the rear mark.

•250- and 300-mm Lanterns and 190-mm Beacon. The method for checking the focus of these lanterns is the same as that used for the 155-mm lantern and shown in Figure 6-10. Only the appearance of the sighting marks may change from lantern to lantern. However, with these lanterns, the signal lamp is replaced with a focus fixture (see Data Sheet 6-D(3)) before making the checks. Additionally, a focus lens (Figure 6-12) shall be used when focusing the 300-mm lantern. Three adjustment screws shown on Figure 6-13 are used to position the focus fixture in 250-mm lanterns and 190-mm beacons. The three white focusing knobs used in the 300-mm lanterns are shown in Figure 6-14. Figure 6-11 shows the acceptable focus for these lanterns. Remember that each panel of the 190-mm beacon has a sighting mark.

•FA-240. This lantern shall be focused *only* in a properly equipped shop. If for any reason the shop focus settings are disturbed, the lantern shall be re-

placed with one that has been shop focused.

1. Lantern Focusing

a. Mount and level (see Section A, Selection Guide, and Section D, General Description Data Sheets) the lantern on a workbench located 25 to 30 ft from a flat, vertical wall in a darkened room. Establish and aim the lantern at a 12-in. diameter target, as shown in Figure 6-15.

b. Select a group of lamps which have straight filaments with no obvious distortions. Install one of these in the lantern.

c. Connect the flasher and lamp-changer so that the lamp burns steadily and the changer does not rotate. (NOTE: This is accomplished by removing the blue wire from the blue terminal and letting it hang free, removing the red wire from the red terminal, and connecting *both* the red and black wires to the positive terminal of the flasher.)

d. The process of adjusting the filament to the focal point of the

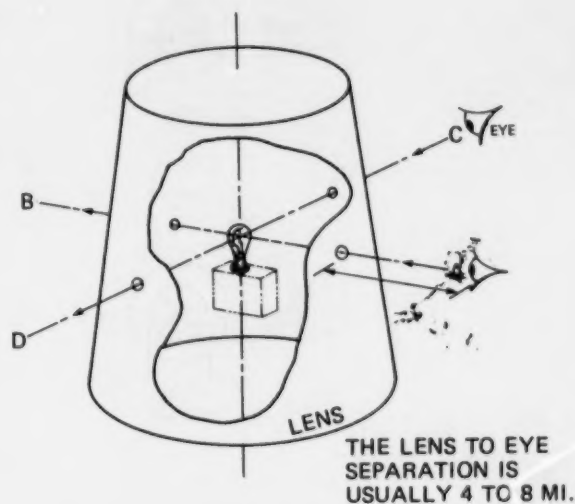


Figure 6-10. Procedure for checking the focus of drum lenses.

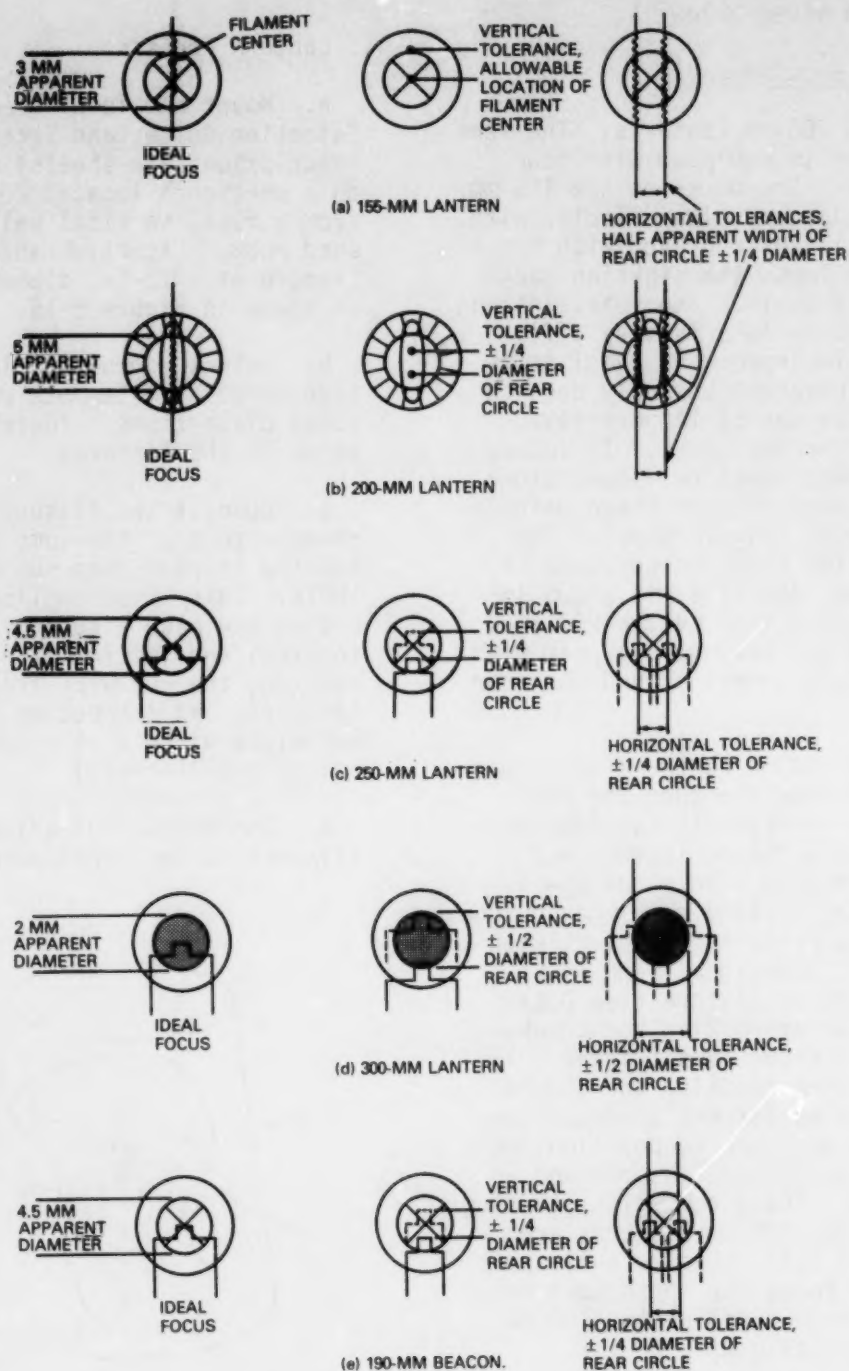


Figure 6-11. Focus standards for 155-, 200-, 250-, and 300-mm lanterns, and 190-mm beacon.

Focusing (cont'd).

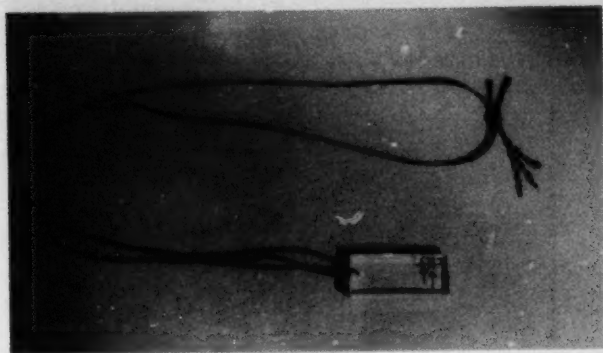


Figure 6-12. Focusing lens for use with 300-mm lanterns.

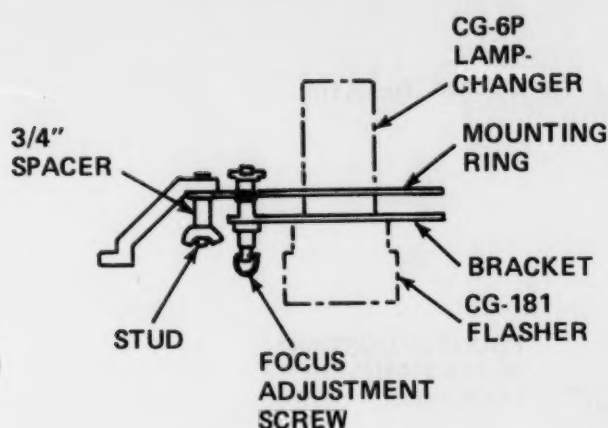


Figure 6-13. Focus adjustment screws on the installed mounting ring of a 250-mm lantern.

optic shall begin with all focusing screws fully tightened until all focus springs are fully compressed (Figure 6-16). When this is done, the light pattern observed on the wall will be an extended star with sharp boundaries around a dark center, which must fall in the center of the target. This step establishes a beginning point at which the axis of the beam is both horizontal and aligned with the vee sights on the lantern.

e. In progressive steps, adjust the filament location toward the focal point, taking extreme care to ensure that all focusing screws are turned



Figure 6-14. The installed tripod and three white focus knobs in a 300-mm lantern.

exactly the same amount in each step. If this care is not exercised with the wider pattern Spredlite lens, it is possible to focus the lantern so that the light is properly concentrated and the beam horizontal, but with the beam skewed horizontally from the axis of the vee sights. Final focus is at the point where the image is the most definitive and clear at the edges of the light pattern, and the pattern is centered on the target. Required patterns for the various lenses are as follows:

- 3.5° X 2° lens - a pattern of rectangular shape, 10 in. high and 20 in. wide
- 8° X 2° lens - a pattern of rectangular shape, 10 in. high and 42 in. wide
- 30° lens - a band pattern approximately 4-1/2 in. high (at 25 ft, this pattern will be very wide, probably not measureable on the wall or screen being used).

2. Lamp Selection. The FA-240 is so critical to proper focus that the lamp manufacturer's normal tolerances for filament placement are not adequate.

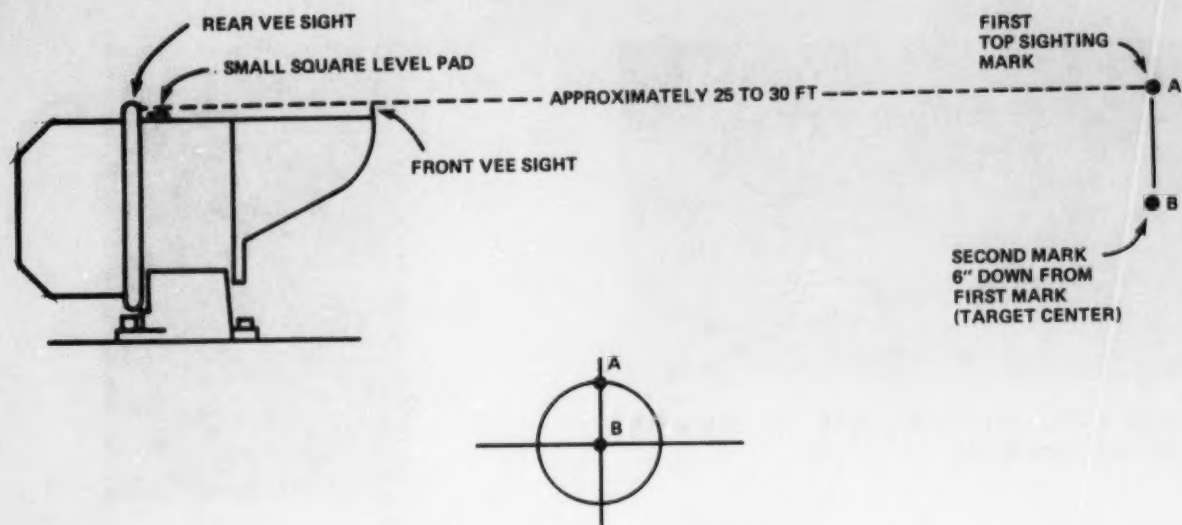


Figure 6-15. Target circle for FA-240 focusing.

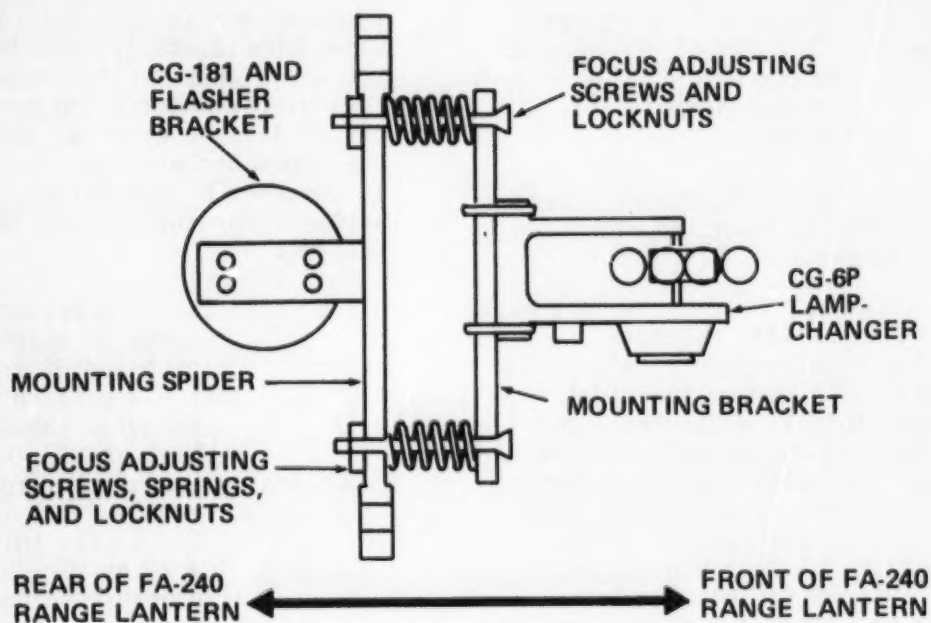


Figure 6-16. Interior assembly of the FA-240 showing focusing screws and their effect on lamp position.

For this reason, only those lamps which have been hand selected and *bench tested* in a lantern shall be used. Each lamp shall produce a pattern that is within 1/2 in. of the original pattern. At the time lanterns are focused, spare lamps shall be selected and tested, and specially marked and stored, in sufficient number to meet future field replacement requirements. These marked lamps can be used to bench-focus an FA-240 lantern at a base, which can then be used to select additional lamps. This will increase the stock of lamps available for field replacement.

.FA-251-AC. Focusing instructions are in the manufacturer's manual (Automatic Power FA-251 Rotating Beacon AC).

.DCB-24 and DCB-224. Follow the instructions of paragraphs 7.4.1, 7.4.2, and 7.4.3 of the Carlisle and Finch Bulletins for adjusting and focusing the optic. These instructions also apply to the older Crouse-Hinds beacons.

Wiring

155-, 200-, 250-, and 300-mm Lanterns. These lanterns shall be wired as shown in Figure 6-17. Table 6-7 gives the maximum length of power cable allowed for 12 Vdc installations.

FA-240 and 190-mm Rotating Beacon. For the FA-240 and the 190-mm beacon, it is necessary to replace the WK-681 wiring kit with three color-coded, 16 AWG, 1 ft long wires.

Synchronized Lights. Synchronized lights shall be wired in accordance with Figures 6-18 or 6-19, as applicable.

FA-251-AC. Wire this optic in accordance with the manufacturer's manual. (Automatic Power FA-251 Rotating Beacon AC).

DCB-24 and DCB-224. Wire these beacons in accordance with Crouse-Hinds Bulletin A-229-3/61 for beacons of that

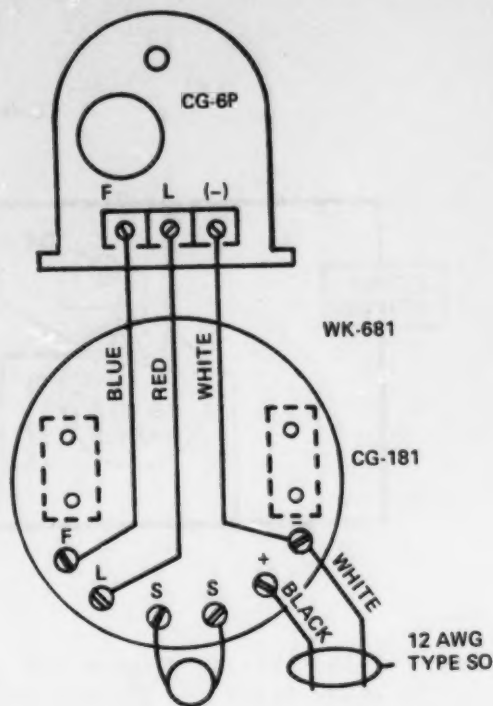


Figure 6-17. Wiring diagram for standard 12 Vdc equipment.

manufacturer and with Instruction Book Nos. M24B263 and M24B262, of 1974, for the Carlisle and Finch DCB-24 and DCB-224, respectively.

Table 6-7
12 Vdc Power Lines

Lamp (A)	Maximum Length of Two-Conductor, 12 AWG Power Cable (ft)
3.05	10
2.03	15
1.15	27
0.77	40
0.55	61
0.25	125

The allowed length of 9 AWG power cable is twice that tabulated for 12 AWG power cable. The allowed length of 6 AWG power cable is four times that tabulated for 12 AWG power cable.

COMMON POWER SOURCE

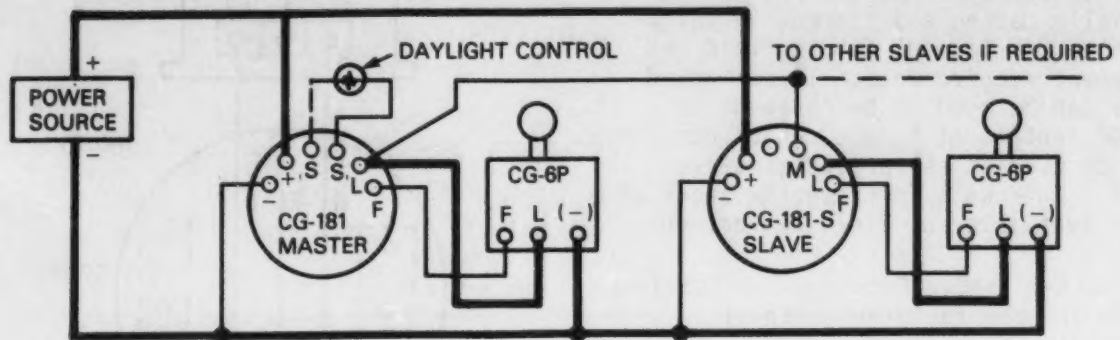


Figure 6-18. Wiring diagram for synchronized lights with a common power source (the heavy lines are the current carrying lines and must meet the restrictions of Table 6-4).

SEPARATE POWER SOURCES

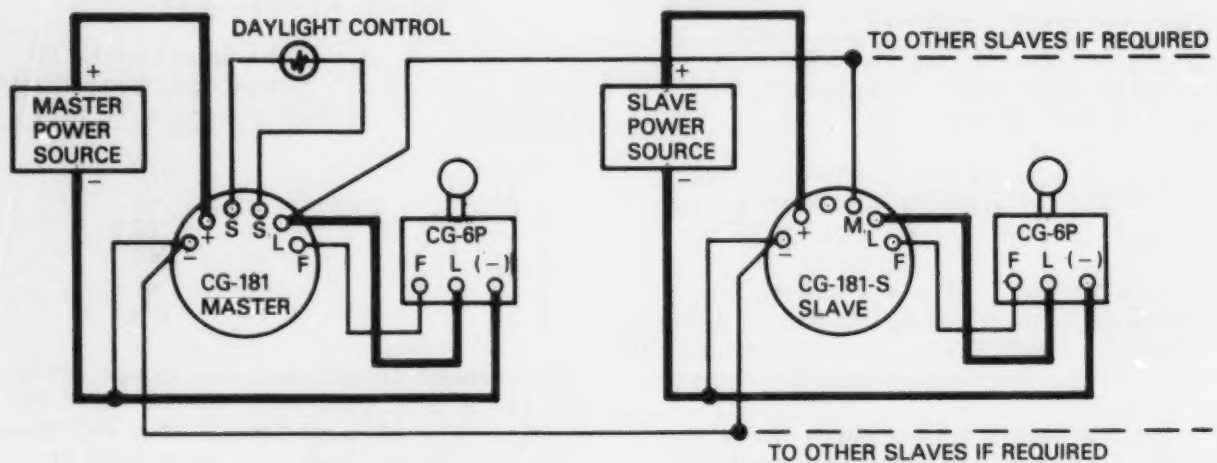
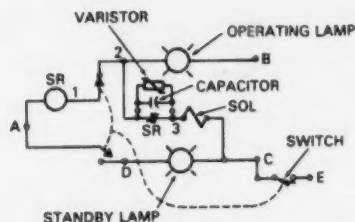
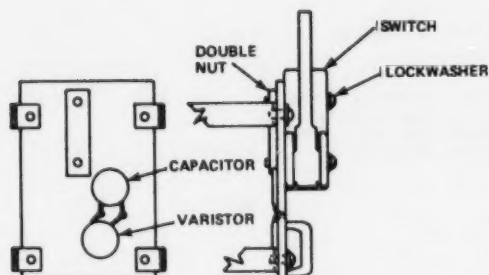
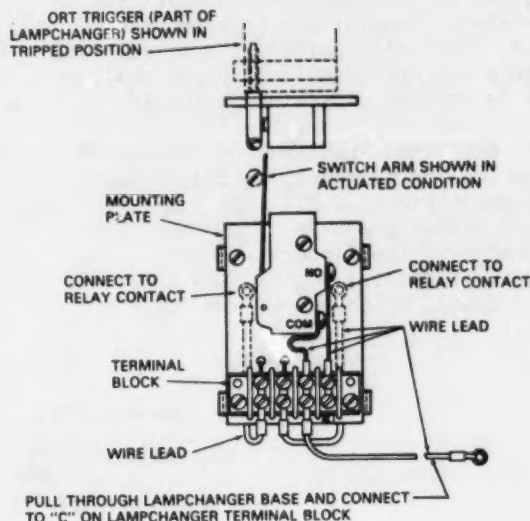
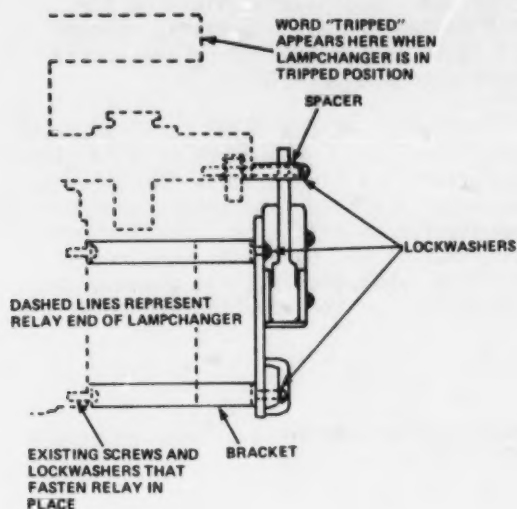


Figure 6-19. Wiring diagram for synchronized lights with separate power sources.

Wiring (cont'd)

•Modification to the Carlisle and Finch Lampchanger. The Carlisle and Finch lampchanger can be modified for arc suppression and a lampchanger mode detection terminal. This modification is needed when the lampchanger is used in a fixed optic and the light is flashed. Lampchangers in the DCB-24 and DCB-224 do not need this modification. The modification kit, shown in Figure 6-20, is available from G/EICP as APA material.

•Wire Entry on the Carlisle and Finch Beacon. A cover assembly, which is a 1/4-in., removable steel plate, is provided for installing entrance bushings or stuffing tubes for the electrical cable. Holes for these bushings or stuffing tubes shall be drilled at the shop prior to installation of the beacon. The cover is not intended for use as a servicing access plate.



ELEMENTARY WIRING DIAGRAM
(COMPLETE LAMPCHANGER INCLUDING THIS MODIFICATION KIT)

Figure 6-20. Modification kit plan for the Carlisle and Finch lampchanger.

Mounting and Leveling

Fixed Aids

.155-, 200-, 250-, 300-, and 190-mm Omnidirectional Aids

1. **Mounting.** These lanterns are mounted on structures with the hardware configuration shown in Figure 6-21. Three capscrews shall be used to secure each lantern. Use only three of the four mounting holes on the 250-mm lantern and the 190-mm beacon. If the platform is severely tilted, longer capscrews may be needed. The capscrews can be replaced by threaded running stock cut in 4-1/2-in. lengths and an extra lock nut. The nuts, washers, capscrews, and stock are procured locally and shall be of galvanized or stainless steel.

2. **Leveling.** Lanterns on structures are leveled by adjusting the hardware shown in Figure 6-21. Use a bubble level with at least a 3-in. flat base to determine if the lantern is level. The exact handylevel no. 49 (NSN 5210-00-516-3356), which has a 9-in. base and

vertical, horizontal, and 45-degree bubble vials, and the pocket level (NSN 5210-00-223-9604), which has a 3-in. base and only a horizontal vial, or levels of equivalent sensitivity shall be used. The 9-in. level is ideal for use on the 155- and 200-mm lanterns since the pots of these lanterns are about 8 in. in diameter. For the 250- and 300-mm lanterns and the 190-mm beacon, a 2-ft carpenter's level is recommended. On these lanterns, the bubble levels built onto the lantern may not be reliable. The circular level on the 250-mm lantern and 190-mm beacon are easily removed and should be discarded if inaccurate. The plastic vials on the 300-mm lantern are not easily removed. If these levels are inaccurate, cover them with opaque paint.

The use of the level is illustrated in Figure 6-22. The level must be placed parallel to a line passing through any two mounting holes and then placed perpendicular to this line. The lantern is level if the bubble is centered in the vial when the level is placed, as described, on the open lantern pot.

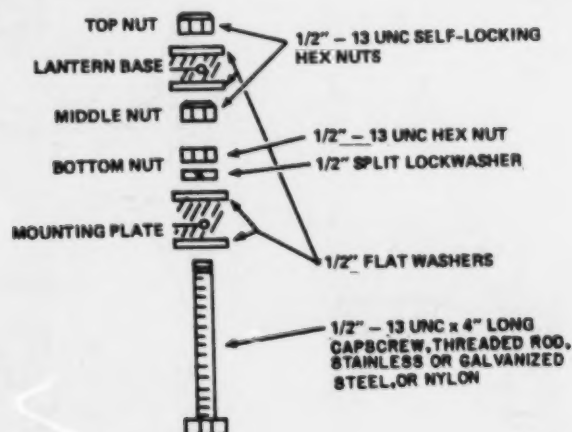
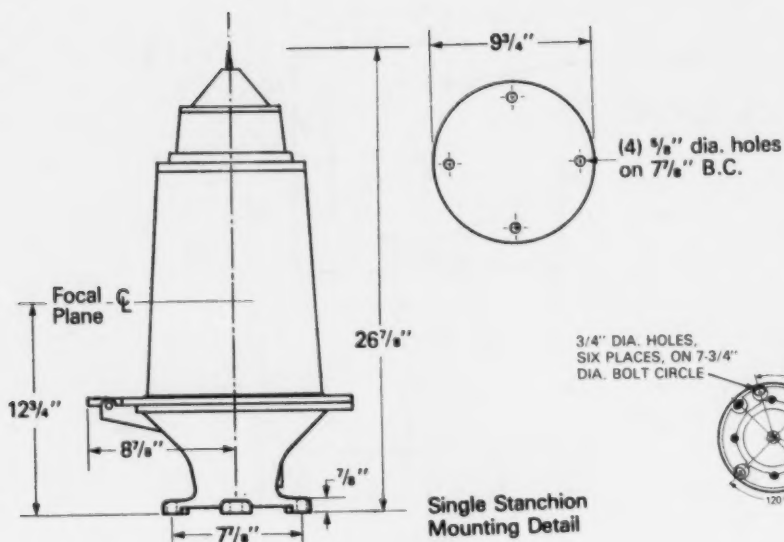
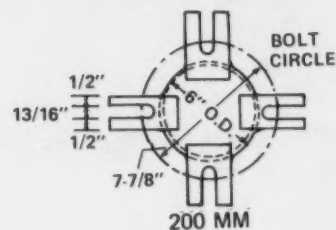
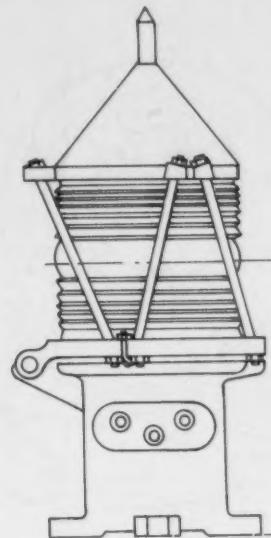
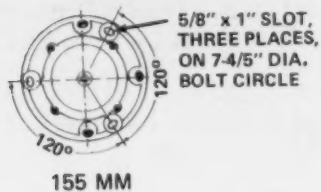
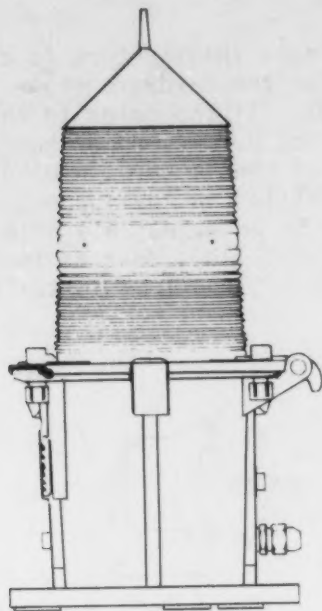


Figure 6-21(a). Hardware configuration for installation on fixed aids.



Weight 19 1/2 lbs.

190 MM
250 MM

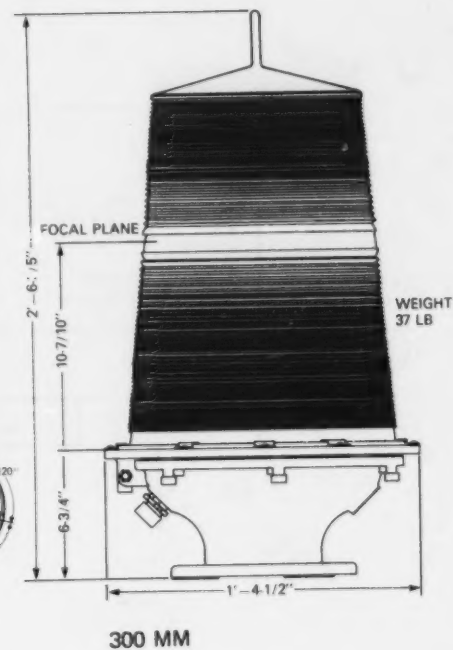


Figure 6-21(b). Base mounting hole arrangements for 155-, 200-, 250-, and 300-mm lanterns, and 190-mm beacon.

1. Mounting. This lantern is also mounted with the hardware shown in Figure 6-21. If the holes in the platform will not permit proper horizontal alignment of the lantern, new holes shall be drilled in the supporting structure, or an adjustable azimuth adapter (turntable), such as that shown in Figure 6-23, shall be installed.

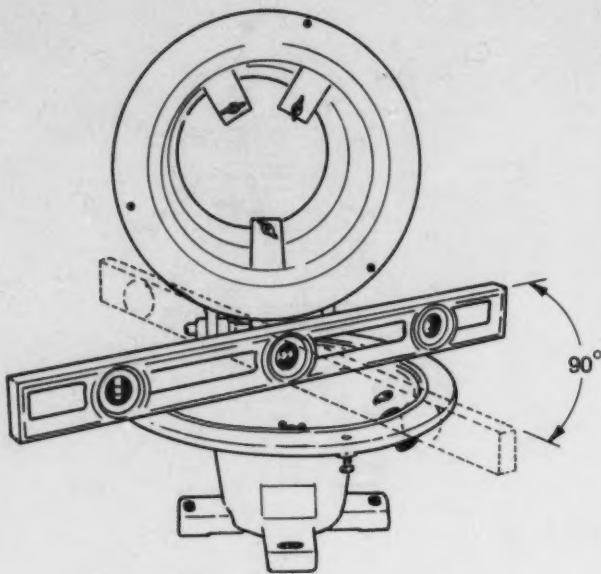
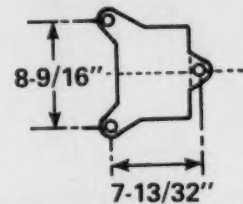


Figure 6-22. Checking the levelness of a lantern.



LOCATION OF HOLES FOR
3/8" MOUNTING BOLTS

Figure 6-23(a). Bottom view of FA-240 base showing location of mounting holes.

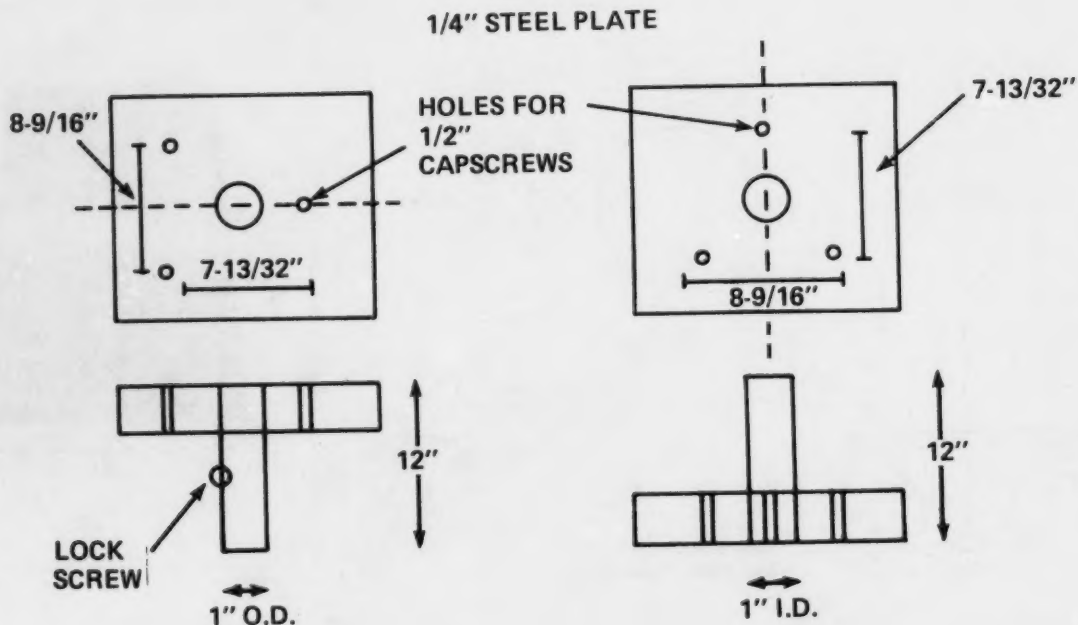
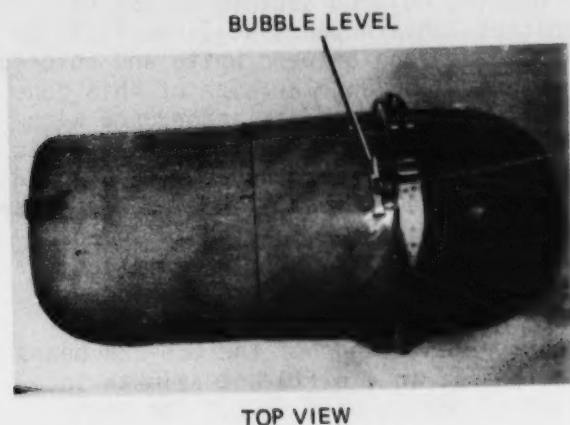


Figure 6-23(b). Azimuth adapter for mounting the FA-240 to the tower platform.

Mounting and Leveling (con't)

2. Leveling. Levelness in the axis perpendicular to the axis of the light beam is checked by placing a 3-in. level across (displaced 90 degrees from the light beam axis) the square flat surface in front of the rear vee sight. If the natural horizon is visible, the axis of the light beam can be directed by aiming the vee sights at the horizon. If the horizon is not visible, levelness in the axis shall be checked with a bubble level in the same manner as the axis perpendicular to the light beam axis. The bubble shall be centered when the level is placed in both directions (Figure 6-24).



Place a bubble level with a 3-in. base on the flat surface adjacent to the rear vee sight. The axis of the level should be perpendicular to the direction of the light beam.

Figure 6-24. Checking the level of an FA-240.

FA-251-AC. Mounting and leveling is discussed in the manufacturer's manual (Automatic Power FA-251 Rotating Beacon AC).

•DCB-24 and DCB-224. Mounting and leveling shall be in conformance with Bulletin A-229-3/61 for Crouse-Hinds beacons and Instruction Book Nos. M24B263 and M24B262, of 1974, for Carlisle and Finch beacons.

Buoys

•Approved Lanterns. Only 155- and 200-mm lanterns are authorized for use on buoys.

•Mounting. All parts of the buoy cage shall be at least 4 in. below the bottom of the lens. Connections shall be made with three capscrews for the 155 mm and four for the 200 mm, and with associated hardware, as shown in Figure 6-25. Nuts shall be tightened just to the point that lockwashers are flush.

•Leveling. Leveling of lanterns on buoys is not required provided that the buoy body or cage is not distorted. Buoys with significant distortion should be used only temporarily in emergencies.

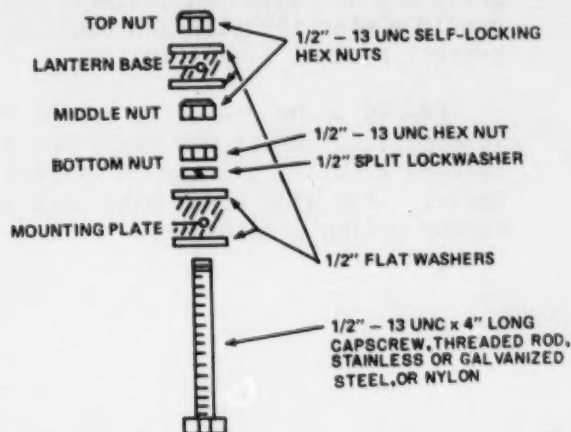


Figure 6-25. Hardware configuration for mounting 155- and 200-mm lanterns on buoys.

Mounting and Leveling (con't)

Horizontal Alignment of Directional Lanterns

Establishment of the Required Beam Axis

Azimuth beams can be aimed with an accuracy of less than ± 0.25 degrees of arc with the vee sight on the FA-240 and with an A/N School sighting bracket on the 250-mm (which is equipped with sectors or condensing panels).

Alignment of Lanterns

•250-mm with Condensing Panels and Color Sectors. The azimuth sighting of condensing panels and color sectors used with the 250-mm lantern shall be done with a sighting bracket. The sighting bracket was developed by the A/N School, which offers instructions in its use. A sighting bracket is being designed for use as a standard Coast Guard tool for aiming beams from the 250-mm lantern. A general description sheet and installation criteria will be provided when the standard sighting bracket becomes available.

•FA-240. The vee sight on the FA-240 is adequate for azimuth aiming of this lantern with 3°, 8°, and 30° Spredlite lenses. The wide beams make more accurate aiming unnecessary.

Lantern House Requirements

Ventilation. Lantern houses shall be provided with sufficient rainproof vents so as to equalize the inside and outside temperatures. Failure to comply with this requirement may cause fogging (condensation) on the lantern panes.

Prevention of False Flashes. Lantern panes shall be slanted in accordance with *Visual Signaling: Theory and Application to Aids to Navigation*, CG-250-37, to ensure that rotating beacons do not produce false flashes.

Control of Ambiguous Color Sectors. Producing colored sectors by use of colored lantern panes will result in an ambiguous zone between white and colored sectors. The angular size of this zone shall be calculated in accordance with CG-250-37. If a DCB-224 rotating optic is used in a lantern house with colored sectors, the two beams shall be separated by 180 degrees and pointed in a radial direction from the axis of rotation, or the two beams shall be separated by 90 degrees, as shown in Figure 6-26. Other orientations of the DCB-224 beams can result in a different azimuth location of the colored sector for each beam.

Lanterns with the CG4P-120 Lampchanger/FLAC
300 120VAC Flasher

Receiving

CG4P-120. The receiving unit shall mark the IDENTIFIER on the E/GICP shipping invoice and mail the invoice to Tideland Signal Corporation, P.O. Box 52430, 4310 Directors Row, Houston, Texas 77052, Attention: Warranty Repair. A copy of this record should also be retained.

FLAC-300. Retain a copy of the shipping invoice for warranty repair.

Mechanical Assembly

Installation of the Lampchanger/Flasher Unit in the 300mm Lantern. A lampchanger/flasher mounting bracket may be attached to the lampchanger when the unit is shipped. If not, install the bracket onto the bottom of the lampchanger using the 10-32x1/2 inch long screws supplied with the unit. The flasher should have 3 color coded wires attached to the terminals. If not, see the wiring section for the proper installation of these wires. The flasher is attached to the mounting bracket with the 8-32x5/16 inch long screw supplied with the unit. Install the lampchanger/flasher on the tripod (removed from the lantern unit, see Figure 6-25(a)) and install in the lantern (see Figure 6-25(b)).



Figure 6-25(a) 300mm Tripod

Installation of the Lampchanger/Flasher Unit in the 250mm Lantern. If the mounting bracket is supplied with the lampchanger unit, remove the bracket from the unit. The flasher should have 3 color coded wires attached to the terminals. If not, see the wiring section for the proper installation of these wires. If the flasher is going to be used a 1/4 inch hole must be drilled in the center of the bracket. To find the center, draw 2 diagonal lines connecting the holes that mount the lampchanger, as shown in Figure 6-25(c). Using the 4 10-32x1/2 inch long screws supplied with the lampchanger mount the lampchanger on the bracket. The T-shaped mounting surface must be positioned with the T-head on the side opposite the lampchanger TEST pushbutton. Install the flasher using the 8-32x5/16 inch long screw supplied with the unit as shown in Figure 6-25(d). Install the Lampchanger/flasher unit into the 250mm lantern using the 3/4 inch spacers mounted between the lantern support arm and the mounting ring as shown in Figures 6-25(d) and 6-25(e).

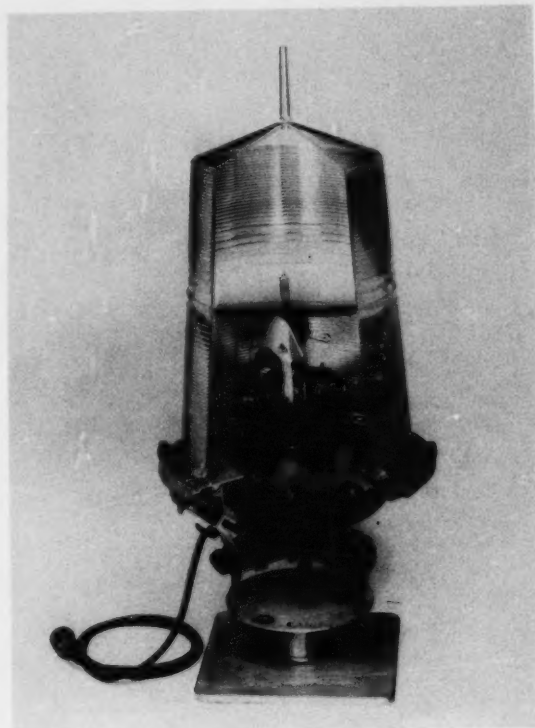


Figure 6-25(b) 300mm

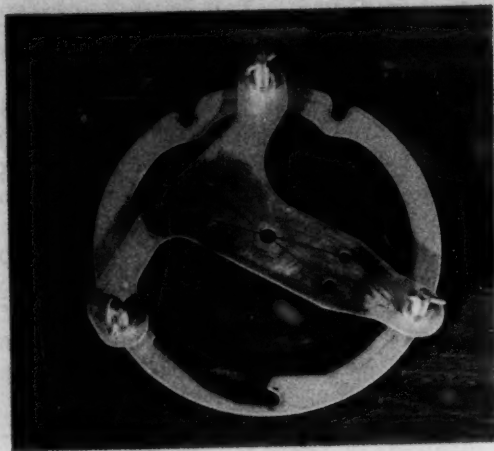


Figure 6-25(c) 250mm Ring

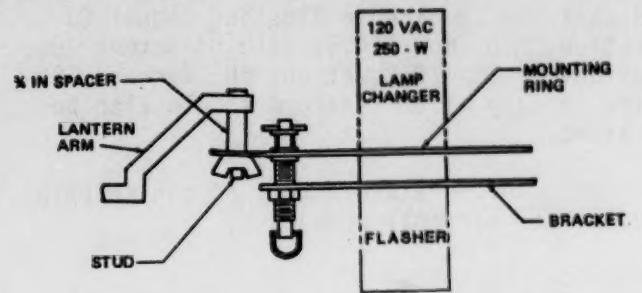


Figure 6-25(e) 250mm Installation

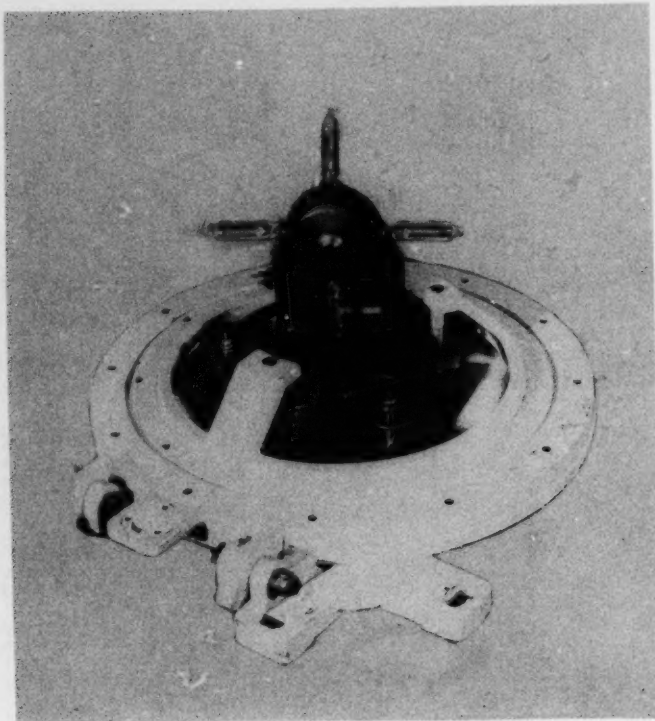


Figure 6-25(d) 250mm

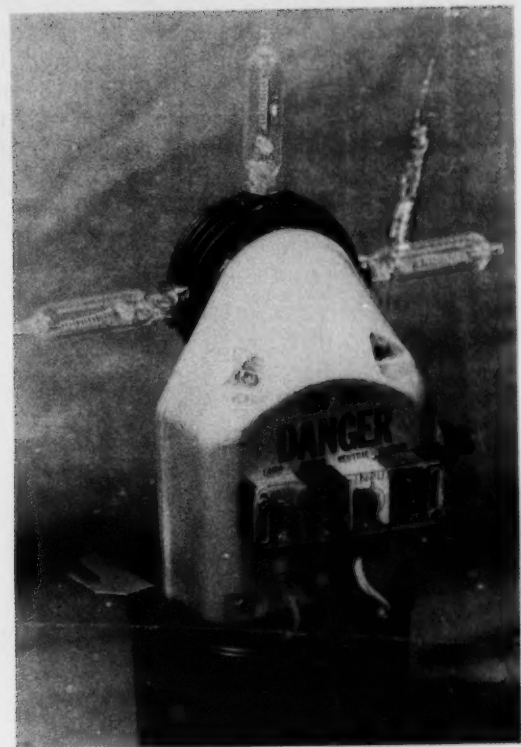


Figure 6-25(f) Flasher/Lampchanger Wiring

Wiring

General. The cable entering the lantern should be 3 or 4 conductor #12 AWG, color coded to match the terminal blocks on the lampchanger. Terminate each wire with a 3/8 inch wide hook tongue spade lug for a No. 8 screw. When using the FLAC-300 remove the shorting strap between the motor and lamp terminals of the lampchanger. The flasher is supplied with 3 color coded wires which are attached to the lampchanger and flasher, as shown in Figures 6-25(f) and 6-25(g). The red, black and white wires are attached to the lamp, motor and neutral terminals, respectively. Install the acrylic safety cover over the terminals on the lampchanger, as shown in Figure 6-25(f).

Modes of Operation. The lampchanger has two modes of operation:

1. Unmonitored Mode

a. In the unmonitored mode with the lamp-changer displaying a continuous "FIXED ON" characteristic (no flasher is used) the motor and lamp terminals are electrically connected by a shorting strap and the lamp out sensing and turret activation are accomplished with the same voltage that is applied to the lamp circuit at the lamp and neutral terminals.

b. In the unmonitored mode with the lamp-changer daylight controlled and/or flashed, the lamp and motor terminals are electrically isolated by at least 10 megohms and lamp out sensing and turret activation are accomplished with voltage supplied by the flasher.

2. In the monitored mode the lamp and motor terminals are electrically isolated by at least 10 megohms and independent voltages applied at the lamp and motor terminals with a common neutral terminal.

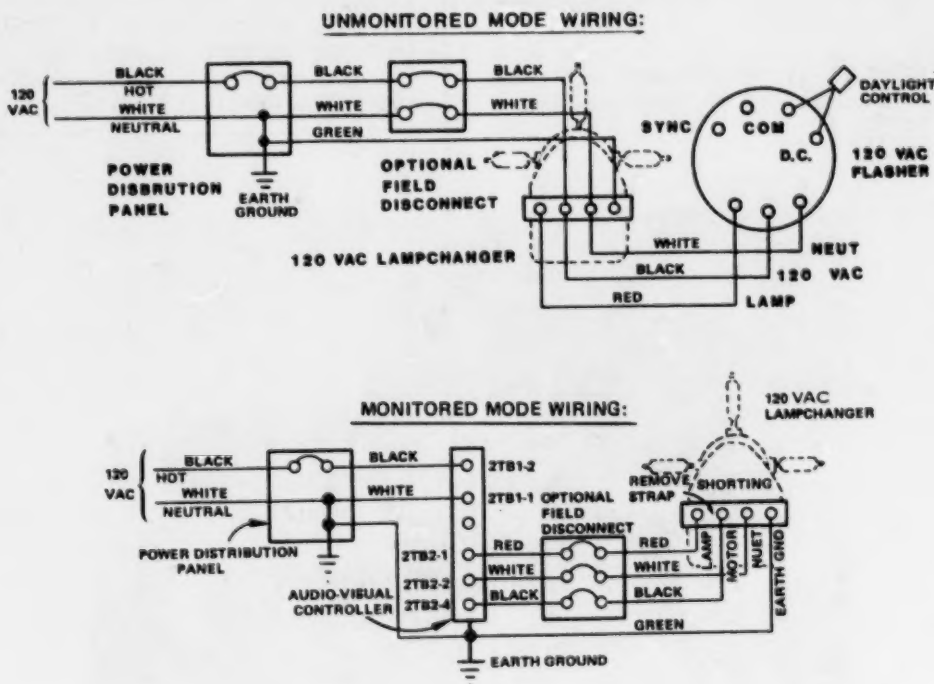


Figure 6-25(g) Wiring Diagrams

Safety Precautions

1. Because 120 VAC power is applied to the lampchanger/flasher unit, caution must be taken when installing, testing, or servicing them. In the event of a unit failure or malfunction, caution must be taken when determining the cause(s) of failure. Danger may be present even if the lamps are not functioning. Note the words "DANGER 120 VAC", shown on the cover of the unit (Figure 6-25(h)). Power must be removed for all service functions.

2. The lamps are pressurized (approx. 300 psi); protect from scratches. The envelope temperature of an operating lamp can exceed 500°F so it will remain hot for several minutes after the power is turned off.

Installation and Removal of Lamps

1. Be sure power is off when installing or removing lamps. The lamp must be handled with the protective wrapper provided by the manufacturer. To install the lamps, simply press straight forward into position until the bayonet pins lock in place. Remove the wrapper after the lamp is in place.

2. Lamp installation is recommended with the turret rotated (X-position) so that no lamp

compresses the spring contacts. Ensure that the turret clamp SNAPS into position over the bayonet pins. Remove the wrapper after the lamp is in place.

3. To remove the lamp, lean it toward the front (away from the frame) to free it from the clamp, then pull upward. DO NOT twist or attempt to pull the lamp straight up.

Focusing

1. The focusing adjustments for the 250mm and 300mm lantern are described on page 6-27. The lantern is focused when the filament of the 120 VAC, 250-W lamp is vertically centered on the lens sighting marks and the width of the filament nearly obscures the rear sighting mark. The apparent diameter of the rear sight ($\approx 4\text{mm}$) is small compared to the filament length ($\approx 17\text{mm}$) which makes vertical positioning easy.

Cooling

1. It may be necessary to provide ventilation to the 300 mm lantern when used in an unventilated lantern enclosure and using the 120 Vac, 250 W lamp on a "fixed" characteristic. This may be done by drilling three 1 inch diameter holes at 120 degree intervals in the top of the lens and removing the unused pipe plugs from the base of the lantern.

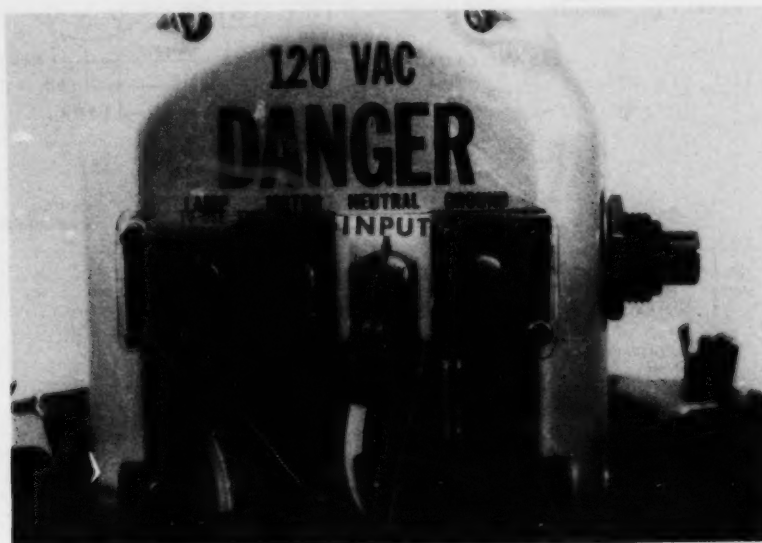
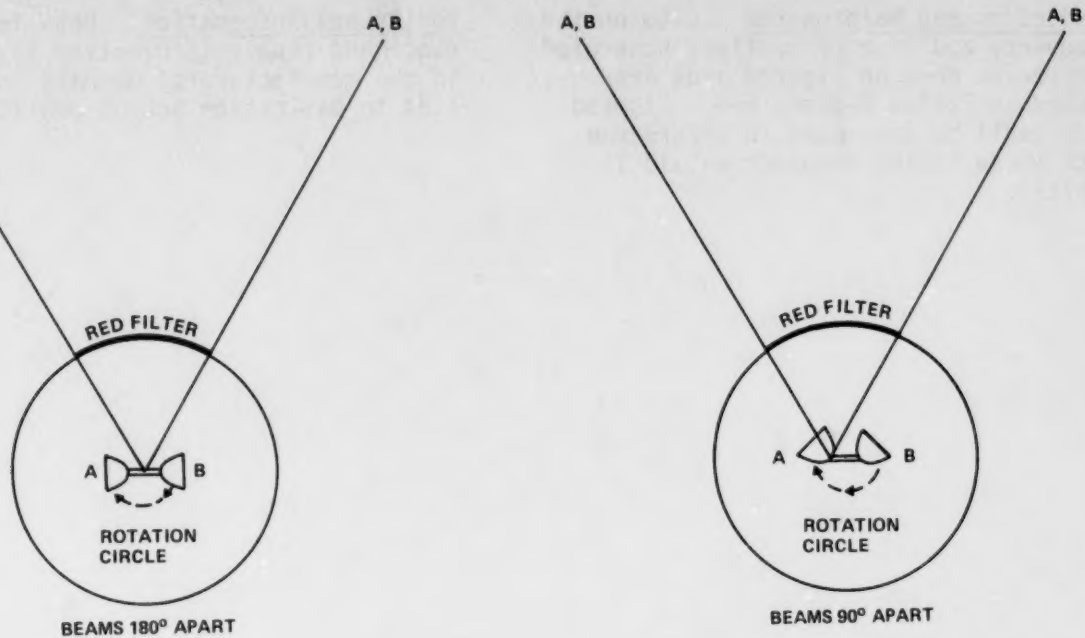
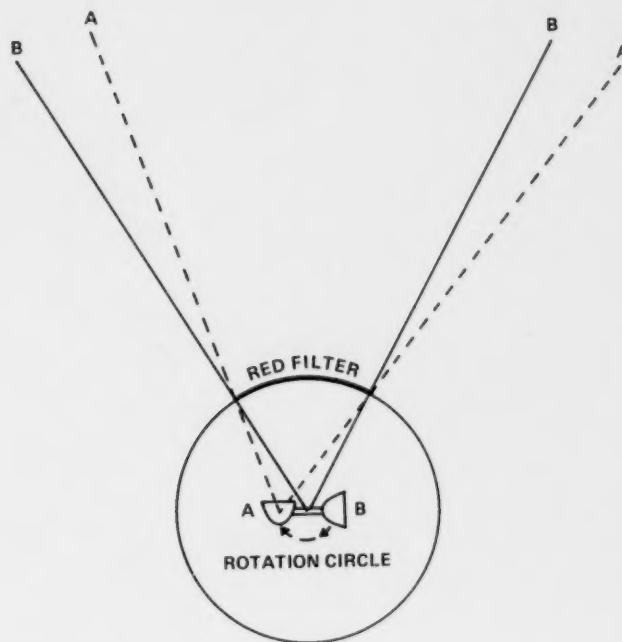


Figure 6-25(h) Safety Cover



(a) Correct alignments



(b) Incorrect alignment

Figure 6-26. Alignment of a DCB-224 when using color sector in lantern panes.

C. INSPECTION, MAINTENANCE, AND REPAIR ON STATION

Inspection and Maintenance. Data on the frequency and type of routine, scheduled work to be done on lighted aids are listed in Tables 6-8 and 6-9. Lighted aids shall be inspected in accordance with these tables whenever an aid is visited.

Additional Information. Detailed maintenance and repair information is provided in the manufacturers' manuals and in Aids to Navigation School publications.

Table 6-8
Annual Field Inspection Requirements for Lights with 12 Vdc Lamps

COMPONENT	155 mm		200 mm		250 mm		300 mm		FA-240		190 mm		ACTION OR POLICY
	X		X		X		X		X		X		
Lens	X		X		X		X		X		X		Clean. Replace if crazed, cracked, or not in "like new" condition.
	X				X				X				Verify that the specified color is used. Verify that the correct green is used--the green Amerace 155-mm lantern has "1-68-1" (not 1-68) molded on the top and the green Tidelands 155- and 300-mm lanterns have adhesive tags on the lens flange, labeled "205C."
			X								X		Check to see that the focus marks are unobstructed and that the focus is correct with a focus fixture.
							X						Use a focus fixture, the focus lens, and the sighting marks on the lens to focus the lantern.
Lens cover	X												Check the focus using the focus marks on the lens and the lamp filament--adjust or replace lampchanger bracket if necessary. Verify that the pot and lens are made by the same manufacturer.
			X								X		Clean. Replace if crazed, cracked, or not in "like new" condition.
			X								X		Verify that the specified color is used. Verify that the correct green is used--the green Amerace 250-mm lantern has "1-68-1" (not 1-68) molded on the top.
					X								Verify that the specified colors and sizes of color sectors are used. Observe the sectors from the marked channel when convenient. Check the azimuth orientation of the sector.

(cont'd next page)

Table 6-8 (cont'd)

COMPONENT	155 mm	200 mm	250 mm	300 mm	FA-240	190 mm	ACTION OR POLICY
Condensing panel			X				OPTION: Verify that the use is authorized. Check the azimuth orientation and verify that the panel is correctly installed.
~~Wind guard~~			~~X~~			~~X~~	~~Check to see that it is correctly installed and not broken.~~
Lantern base	X		X	X	X	X	Replace the lantern if the base is cracked or has extraneous holes. Check the feet and hinge carefully. Ensure that the four 1/16-in. drain holes in the base are clean. Use at least a 3-in. bubble level to verify that the base is level (except on buoys).
Mounting and leveling hardware	X		X	X	X	X	Only three bolts are used to secure the lantern. Make sure that the lockwashers are flush.
Lens clamp and screws	X		X	X	X	X	Check the tight fit of the lens ring to the base and verify that there are no signs of leaks.
Gaskets	X		X	X	X	X	Replace if not "like new."
Bubble levels			X	X	X	X	Bubbles should be centered in the lantern vials; if not, check the level with at least a 3-in. bubble level. Remove any defective level from the 250 mm.
WK-681	X		X	X			Wiring kit is used to connect the CG-6P and CG-181. Replace if wires are frayed or show signs of deterioration.
#16 AWG wires					X	X	Wiring is used to connect the CG-6P and CG-181. Replace if wires are frayed or show signs of deterioration.

(cont'd next page)

Table 6-8 (cont'd)

COMPONENT	ACTION OR POLICY				
	155 mm 200 mm X	250 mm X	300 mm X	EA-240 X	190 mm X
2 - con- ductor #12 AWG SO TYPE CABLE					
Stuffing tube	X	X	X	X	X
Electrical terminals	X	X	X	X	X
OG-181 Flasher	X	X	X	X	X
Daylight controls	X	X	X	X	X
OG-6P lamp- changer	X	X	X	X	X

Cable is used to connect the power source to the OG-181. Replace if wires are frayed or show signs of deterioration.

Replace if it shows signs of leakage or deterioration.

Terminals should be free of corrosion and have a light petroleum jelly or lubricant covering.

Verify that the specified characteristic is used. Replace if the period between flashes differs from the rated interval by more than 6 percent, lampout sensing is faulty or daylight control sensing is faulty.

Suspect flasher voltage regulation failure and remove flasher for testing ashore if, with a proper source voltage, lamps are prematurely burnt out (see Table 9-2) or the lamp burns at reduced intensity.

Check to see that the correct type is used—C (white case) for clear glass or acrylic lenses, R (red case) for colored glass lenses, B (black) case for colored glass lenses, and L (pipe plug) for external use and fixed-on characteristics. Replace if it does not work; if the lens and case are not free of corrosion, discoloration, and cracks; or if the wire insulation or wire seal at the case is not intact. Verify that the preset photoelectric cell angle is not intact. Verify that the preset photoelectric cell angle is not disturbed and the cell not shaded.

Replace if the turret will not ratchet through all positions and stop at the sixth socket (unless

(cont'd next page)

Table 6-8 (cont'd)

COMPONENT	155 mm 200 mm	250 mm	300 mm	FA-240	190 mm	ACTION OR POLICY
12 V lamps	X	X	X	X	X	the fault lies in the flasher lampout sensing) or if the lampchanger contacts are corroded. Verify that the lampchanger and bracket are secure and have no obvious dents or physical damage. The operating lamp must be set in the red-faced turret just before closing the lantern.
	X			X		Replace the operating and burned out lamps. Verify that all lamps have the same specified current rating and that all six lamps burn in the operating position.
				X		3.05 A lamps cannot be used in a CG-6P.
					X	Lamp life with a CG-6P is less than 1 yr.
				X		Use replacement lamps which were preselected when the FA-240 was focused or replace the lantern.
Flasher bracket					X	This bracket is an L-shaped bar--ensure that it is correctly installed.
Lampchanger bracket	X	X	X	X	X	Replace the bracket if bent or damaged. Verify that it is tightly secured.
	X		X			The bracket valley should be in the center when installed () and CG-6P used.
		X				The adjustable ring bracket is used and the spacers are placed under the bracket.
			X			~~A flat bracket is used on the tripod.~~
Lens assembly				X	X	The FA-240 cannot be focused in the field. If the lens assembly rotation speed differs from the rated speed by 6 percent when the input voltage exceeds 11.5, replace the lantern. Verify that the lens assembly rotates when the lamp is on and off; if it does not, replace the lantern.

Table 6-9
Field Inspection Requirements (Annual and Semiannual) for Lights with 120 Vac Lamps

COMPONENT	FA-251		DCB-24		VENTED		ACTION OR POLICY
	AC		DCB-224		250 mm	300 mm	
Cover glass and lens cover	A		S		A		Clean. Replace if cracked, crazed, or not in "like new" condition. Verify that the specified color is used--if green, the 250-mm cover has "1-68-1" (not 1-68) molded on the top.
			S				Ensure that good ventilation prevents window fogging if sheltered in a lantern house.
					A		Verify that the correct colors and sector sizes are used for any color sectors. Check the orientation of the color sectors.
Bird guard			S				Check to see that the lantern house window panes have correct color and landside shields.
					A		Verify that the bird guard is installed and not damaged.
Lens	A				A	A	Clean. Replace if cracked, crazed, or not in "like new" condition.
Condensing panel	A				A	A	Verify that focus marks are unobstructed and the lantern is focused.
	A					A	Verify that the specified color is used--if green, make sure that the 300-mm lens has an adhesive tag on the lens flange, labeled "205C."
						A	Verify that the correct colors are used.
					A		Verify that the panel is authorized and correctly installed. Check the azimuth orientation.

(cont'd next page)

Table 6-9 (cont'd)

COMPONENT	FA-251 AC	DCB-24 DCB-224	VENTED 250 mm	300 mm	ACTION OR POLICY
Primary mirror		S			Clean. Use at least an 18-in. carpenter level to verify that the mirror is vertical; if not, adjust it. Replace the mirror if it is cracked or the finish is so tarnished that it is not in "like new" condition.
Secondary mirrors		S			Clean. Check alignment with the optical axis and the focus. Replace if cracked or the finish is so tarnished that it is not in "like new" condition.
Base			A	A	Replace the lantern if the base is cracked or has extraneous holes. Check the feet and hinge carefully. Clean the four 1/16-in. diameter drain holes in the base.
	A				Clean the screened drain hole.
	A	S	A	A	Use at least a 3-in. bubble level to verify that the base is level. Remove defective levels built into the lantern.
Lens clamps and screws	A	S	A	A	Ensure that all clamps and screws are tight and secured.
Gaskets	A	S	A	A	Replace gaskets if not "like new."
Bubble levels			A	A	Verify that the lantern is level and that the bubble is centered in the vial of the lantern level; if not, remove the defective lantern level.
Mounting bolts and legs	A	S	A	A	Check to see that only three bolts or legs are used to support and level the lantern or rotating optic, that washers are flush, and that fittings are tight.
Drum housing		S			Verify that the DCB-224 drums have correct relative azimuth positioning and are secured.
Wires	A	S	A	A	Verify that the #12, #14, #16 AWG wires are used as specified. Replace the wires if they are frayed, degraded by heat, show signs of deterioration, or are not in "like new" condition.

(cont'd next page)

Table 6-9 (cont'd)

COMPONENT	FA-251 AC	DCB-24 DCB-224	VENTED 250-mm	300 mm	ACTION OR POLICY
Stuffing tube	A	S	A	A	Replace if there are signs of leakage or deterioration.
Electrical terminals	A	S	A	A	Ensure that the terminals are tight, free of corrosion, and have a petroleum jelly or lubricant covering.
Lampchanger or duplexing		S			Verify that the primary and secondary lamps burn when in the operating position. Verify that the spring tension allows for positioning of the spare lamp without damage to the filament. Replace the lampchanger if a socket is dead or the lampchanger will not rotate. Place the primary lamp at the operating position before leaving.
		S			Check to see that the lamps fit tightly in the bipost sockets.
		S			Verify that the voltage drop does not exceed 0.6 in the lampchanger.
		S			Verify that the lamp filament is at the focal point and 10 in. from the back of the primary mirror.
		S			Verify that the arc suppression kit and monitor terminal are installed and operating correctly.
		S			Verify that the mode detection contacts open and close.
			A	A	Verify that the lanterns are duplexed--with primary light above the secondary, that the secondary light comes on when the primary lamp is removed, and that the lights have the same authorized color and characteristic.
CG4P-120 Lampchanger	A				Replace if the turret will not ratchet through all positions and stop at the fourth socket or if the lampchanger contacts are corroded. Verify that the lampchanger and bracket are secure and have no obvious physical damage.
Lamps	A	S	A	A	Replace the burned out and used lamps. Switch the unused spare lamp to the operating position. Make sure that all lamps burn in the operating position. Do not use lamps with filaments bent half their widths from the vertical.

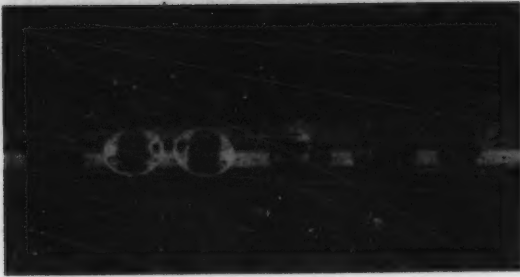
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Table 6-9 (cont'd)

COMPONENT	FA-251 AC		DCB-24 DCB-224		VENTED 250 mm		300 mm		ACTION OR POLICY
	A	S	A	S	A	S	A	S	
Daylight control									Verify that a type L daylight control is used in an ac flash controller. Replace the daylight control if it does not work; if the lens or case is cracked, corroded, or discolored; or if the wires or seal are deteriorated.
									Ensure that the daylight controlled beacon rotates 24 hr/day unless the lampchanger wiring is modified for high-temperature insulation.
	A								Daylight control is supplied by the manufacturer. Replace if it does not work.
Rotation detector	A	S							Verify that the contacts open and close as specified.
Current sensing		S							Verify that the contacts open and close as specified.
Oil gear box		S							Check to see that the oil level is visible in the oil cup at the top of the base. Add oil if needed.
		A							Change oil annually.
		S							Check to see that the vent hole is not clogged.
Collector rings and brushes		S							Clean. Reset brush tension to 1 to 1 1/2 lb if needed.
Turntable assembly	A	S							Verify that the turntable rotates within 6 percent of the rated speed.
Motor		S							Verify that the motor draws less than 4.9 A at 120 Vac with low wind loading.
	A								Verify that the motor draws 0.9 A at 120 Vac.
Spindle bearing		S							Apply silicone grease, Dow Corning #33, medium grade, with a grease gun.

D. GENERAL DESCRIPTION DATA SHEETS

12 V LAMPS



Function. The 12 V marine signal lamps are normally used in fixed lanterns to give a light with a nominal range of less than 9 nmi. These lamps can be used in lanterns to generate pencil beams, color sectors, and omnidirectional lights.

Features

- Omnidirectional light output in the horizontal plane
- C-8 incandescent filament
- 500-hr life expectancy when burned fixed
- Prefocus collar
- Current and voltage rating printed on each lamp bulb
- Shipped 10 to a box
- Single contact base is nickel-plated brass.

Related Equipment. The lamps must be used with a CG-6P lampchanger and a CG-181 flasher. The FA-240 and the 155-, 200-, 250-, 300-, and 190-mm lanterns may be equipped with 12 V lamps.

Additional Data. Technical specifications for 12 V lamps are given in G-EOE Pur-

chase Description No. 243, dated April 1973. The manufacturers are General Electric Co. and Westinghouse Electric Corp. Procurement is through E/GICP.

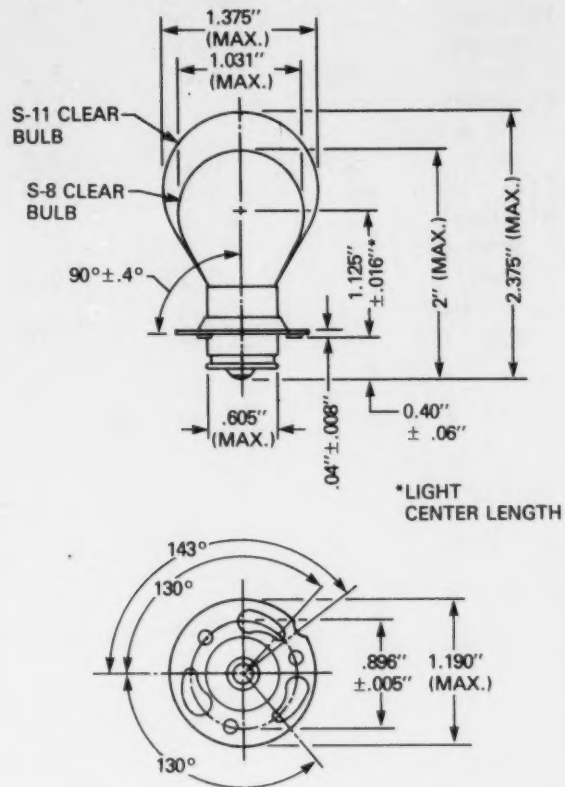


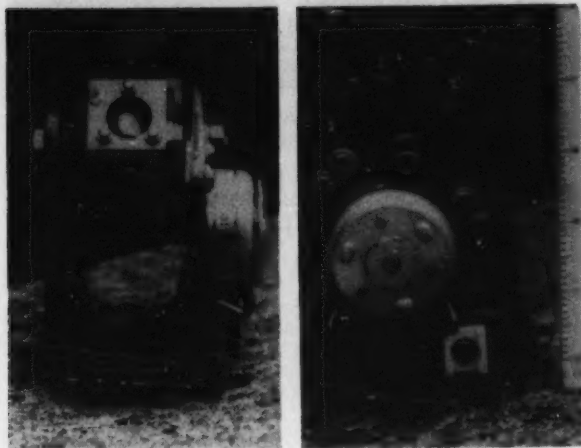
Figure 6-27. Dimensions of the 12 V lamp and the candelabra prefocus single contact base.

Table 6-10
12 V Lamp Characteristics

<u>Features</u>	<u>Tolerances</u>	<u>Lamps</u>					
Lamp current rating (A)	$\pm 7\%$	0.25	0.55	0.77	1.15	2.03	3.05
NSN 6240-00-		032-5034	228-8588	156-1607	262-8841	262-8845	262-8840
Filament height (mm)	$\pm 20\%$	6.0	5.5	7.0	7.0	8.0	9.3
Filament width (mm)	$\pm 25\%$	0.25	0.2	0.3	0.4	0.6	0.8
Clear bulb		S-8	S-8	S-8	S-8	S-8	S-11
Minimum ontime (sec)		0.30	0.30	0.30	0.30	0.30	0.40
Lumen output (lm)	-15%	30	70	120	180	380	600

Data Sheet 6-D(1). (cont'd).

12 V LAMPCHANGER (CG-6P)



Function. The CG-6P lampchanger supports six 12 V marine signal lamps with the filament of the burning lamp at the focal point of the lantern. A spare lamp rotates to the operating position when the burning lamp fails. The lampchanger cannot sense lamp failure; re-lamping is triggered by a pulse from the CG-181 flasher.

Features

- Holds six lamps in a turret
- Three color-coded terminals
- Low cost
- Manually cocked, spring-loaded turret
- Low resistance lamp circuit
- Accurate lamp positioning
- Corrosion resistant
- Shadow-free to 52 degrees below the horizontal
- Shock and vibration resistant
- Operates in the horizontal and vertical positions
- Sixth lamp and 40-ohm resistor are in parallel.

Electrical and Mechanical Characteristics

Input voltage	10 to 14 Vdc
Maximum current	4.0 A
Maximum lamp circuit resistance	0.03 ohms
Solenoid coil resistance	15 ohms
Solenoid coil voltage	8 to 14 Vdc
Solenoid coil pulse duration	0.2 to 5.0 sec

Ambient temperature range 0 to +140 degrees F

Lamp positioning tolerance

Horizontally ± 0.031 in.

Vertically ± 0.010 in.

Related Equipment. The CG-6P lampchanger is only used with 12 V marine signal lamps and the CG-181 flasher. The FA-240 and the 155-, 200-, 250-, 300-, and 190-mm lanterns may be equipped with the CG-6P.

Additional Data. Technical specifications for the CG-6P lampchanger are given in G-EOE Specification 195D of October 1984. Approved manufacturers are listed on the CG-6P Qualified Products List maintained by Commandant (G-FCP-2). Procurement of the CG-6P lampchanger is through E/G-ICP. The stock number is 6250-01-030-3485.

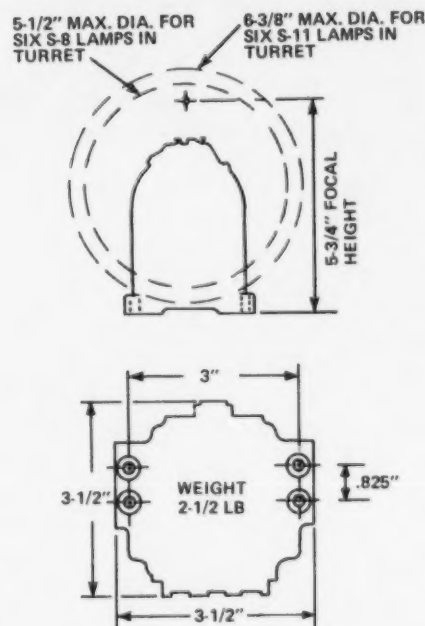


Figure 6-28. Dimensions of the CG-6P--top and side views.

Data Sheet 6-D(2). 12 V automatic lampchanger (CG-6P).

FOCUS FIXTURE



Function. The focus fixture must be used to focus 250, 300, and 190 mm lanterns equipped with a CG-6P lampchanger and standard 12 V lamps.

Additional Data. Procurement is through the manufacturer, Tideland Signal Corp., by term contract.

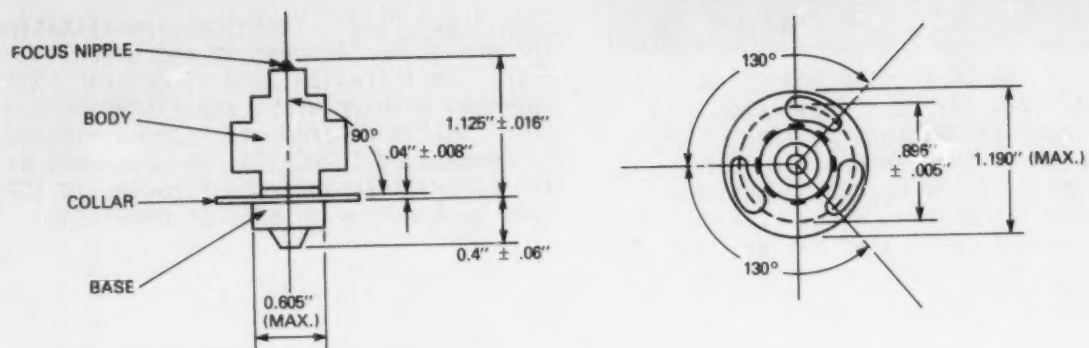
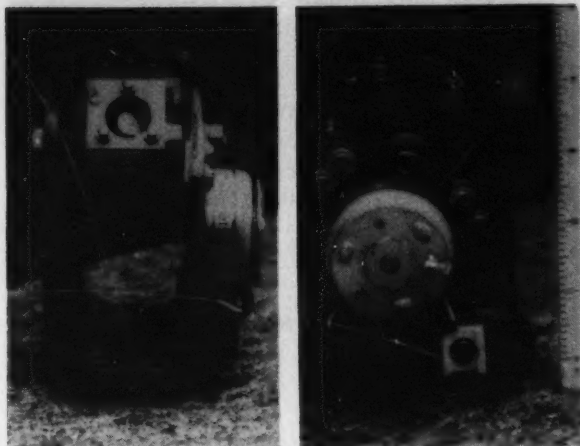


Figure 6-29. Dimensions of the focus fixture.

Data Sheet 6-D(3). Focus fixture.

12 V LAMPCHANGER (CG-6P)



Function. The CG-6P lampchanger supports six 12 V marine signal lamps with the filament of the burning lamp at the focal point of the lantern. A spare lamp rotates to the operating position when the burning lamp fails. The lampchanger cannot sense lamp failure; relamping is triggered by a pulse from the CG-181 flasher.

Features

- Holds six lamps in a turret
- Three color-coded terminals
- Low cost
- Manually cocked, spring-loaded turret
- Low resistance lamp circuit
- Accurate lamp positioning
- Corrosion resistant
- Shadow-free to 52 degrees below the horizontal
- Shock and vibration resistant
- Operates in the horizontal and vertical positions
- Sixth lamp and 40-ohm resistor are in parallel.

Electrical and Mechanical Characteristics

Input voltage	10 to 14 Vdc
Maximum current	4.0 A
Maximum lamp circuit resistance	0.03 ohms
Solenoid coil resistance	15 ohms
Solenoid coil voltage	8 to 14 Vdc
Solenoid coil pulse duration	0.2 to 5.0 sec

Ambient temperature 0 to +140 degrees F range

Lamp positioning tolerance

Horizontally ± 0.031 in.
Vertically ± 0.010 in.

Related Equipment. The CG-6P lampchanger is only used with 12 V marine signal lamps and the CG-181 flasher. The FA-240 and the 155-, 200-, 250-, 300-, and 190-mm lanterns may be equipped with the CG-6P.

Additional Data. Technical specifications for the CG-6P lampchanger are given in G-EOE Specification 195D of October 1984. Approved manufacturers are listed on the CG-6P Qualified Products List maintained by Commandant (G-FCP-2). Procurement of the CG-6P lampchanger is through E/G-ICP. The stock number is 6250-01-030-3485.

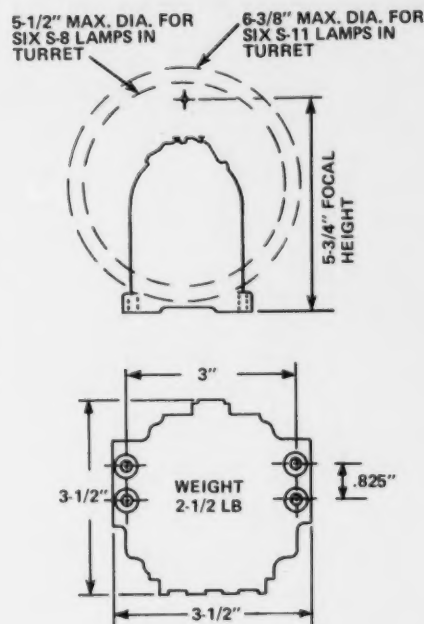


Figure 6-28. Dimensions of the CG-6P--top and side views.

Data Sheet 6-D(2). 12 V automatic lampchanger (CG-6P).

FOCUS FIXTURE



Function. The focus fixture must be used to focus 250, 300, and 190 mm lanterns equipped with a CG-6P lampchanger and standard 12 V lamps.

Additional Data. Procurement is through the manufacturer, Tideland Signal Corp., by term contract.

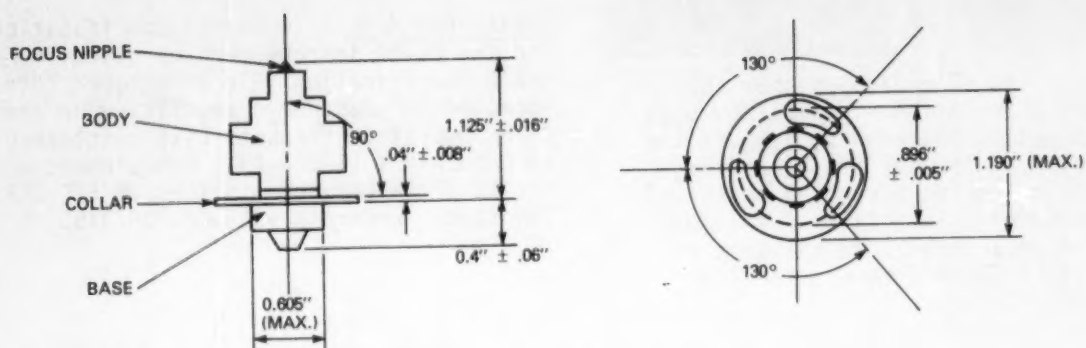


Figure 6-29. Dimensions of the focus fixture.

12 VDC FLASHER (CG-181)



Function. The CG-181 flasher time codes (flashes) and regulates the direct current voltage to the 12 V signal lamps. The flasher senses when the operating lamp fails and causes the CG-6P lamp-changer turret to index to a new lamp. When a daylight control (photoelectric cell) is connected to the CG-181 flasher, the light is turned off during the daylight hours.

Features

- All electrical components are solid state
- Short circuit protection
- Reverse polarity protection
- Nonadjustable
- Wide range of flash characteristics
- Color-coded terminals
- Watertight container
- Low cost and disposable.

Electrical and Mechanical Characteristics

Input voltage	10 to 18 Vdc
Output voltage*	11.7 to 12.2 Vdc
Output current	0.25 to 4.0 A
Ambient temperature range	0 to +125 degrees F
Timing tolerance	±6 percent

*The output voltage is equal to 12 Vdc or to the input voltage less the voltage drop in the flasher (typically 0.4 Vdc), whichever is smaller.

Related Equipment. The CG-181 flasher is needed to complete the ac flash controller and the audiovisual controller, which flash and daylight control 120 Vac lamps.

Additional Data. Technical specifications for the CG-181 are given in G-EOE Purchase Description Number 181B of November 1975. Approved manufacturers are listed on the CG-181 Qualified Products List maintained by Commandant (G-FCP-2). Procurement of the CG-181 flasher with standard characteristics is through E/GICP. Special characteristic flashers must be procured from these approved manufacturers.

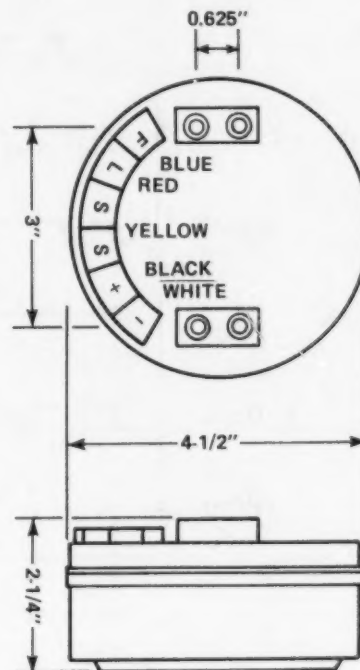
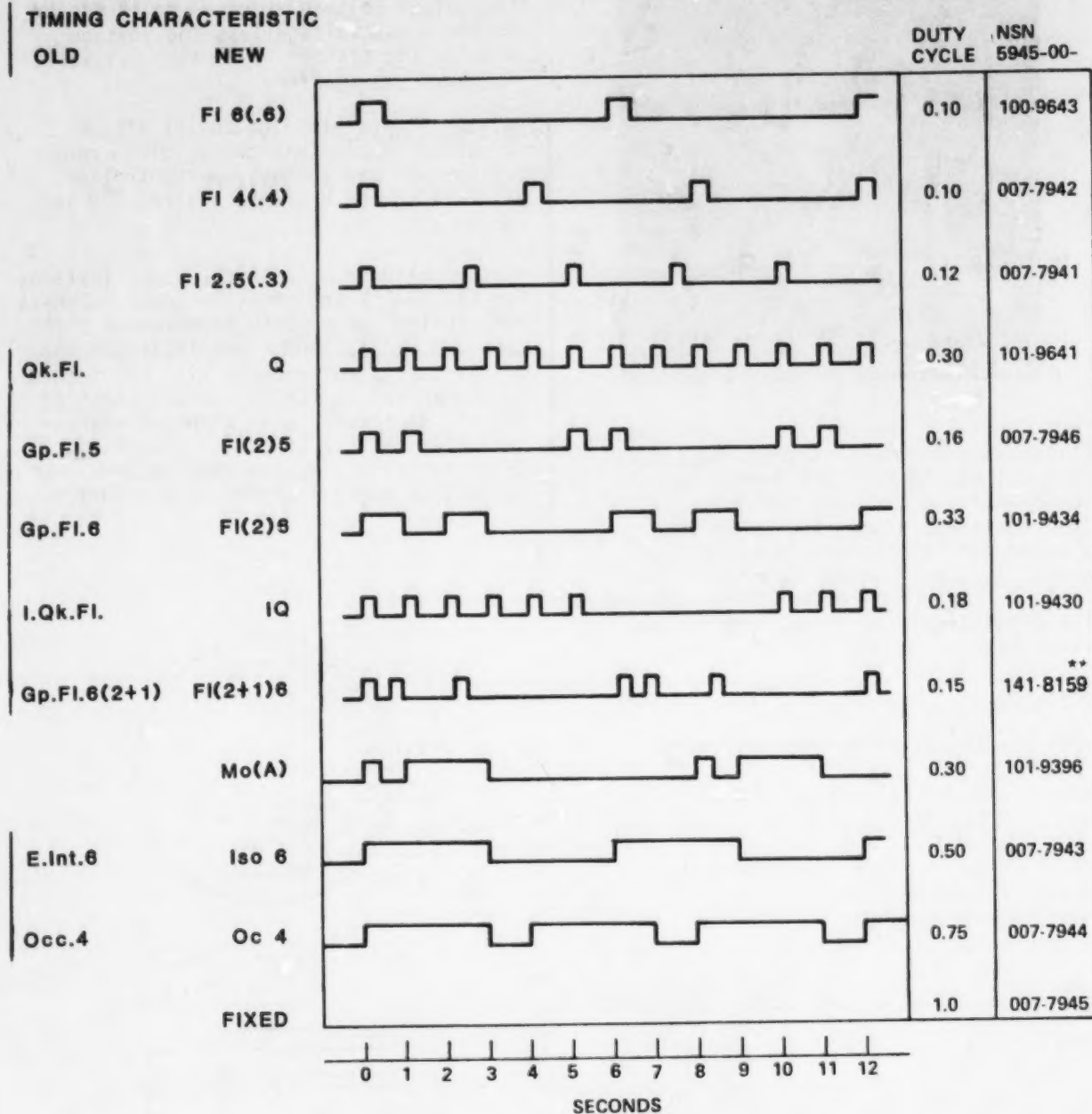


Figure 6-30. Dimensions of the CG-181.

Table 6-11
Standard Flash Characteristics*

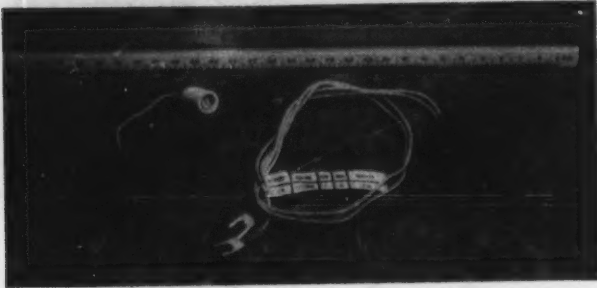


*See Table 6-1 for an explanation of flash characteristic abbreviations.

**The prefix for this stock number is: 5945-01-.

Data Sheet 6-D(4). (cont'd).

DAYLIGHT CONTROLS



Function. A daylight control is a photoelectric cell that senses the amount of daylight. When connected to the CG-181 flasher, the photocell activates an on-off switch that turns the light on in the evening and off in the morning.

Features

- Four standard types
- Color-coded cases
- Hermetically sealed
- Internal and external mounting.

Related Equipment. Coast Guard daylight controls (photoelectric cells) must be connected to the CG-181 flasher. Table 6-9 matches the various lens types with the appropriate daylight control. A type L daylight control must be used in the ac flash controller and the audio-visual controller, which are described in Chapter 8 of this volume. A type L daylight control must be used when a fixed-on characteristic is used.

Additional Data. Technical specifications for the type C, R, B, and L daylight controls are given in G-EOE Purchase Description No. 234, dated February 1973. The manufacturer is Vactec Corp. and procurement is through E/GICP.

Table 6-12
Daylight Control Specifications and Applicable Stock Numbers

Sensor Type	Color	Resistance (ohms)*	Mounting	Lens Type	Lens Color	NSN
C	White	129,000 $\pm$ 20%	Internal	Any	Clear	5961-01-031-8858
R	Red	49,000 $\pm$ 20%	Internal	Acrylic	Red/ Green	6230-01-045-5470
B	Black	16,500 $\pm$ 20%	Internal	Glass	Red/ Green	5961-00-G00-2880
L	Metal	129,000 $\pm$ 20%	External	Any	Any	5961-00-034-6058

*Tungsten source at 2 ft-c illumination.

Data Sheet 6-D(5). Daylight controls (types C, R, B, and L).

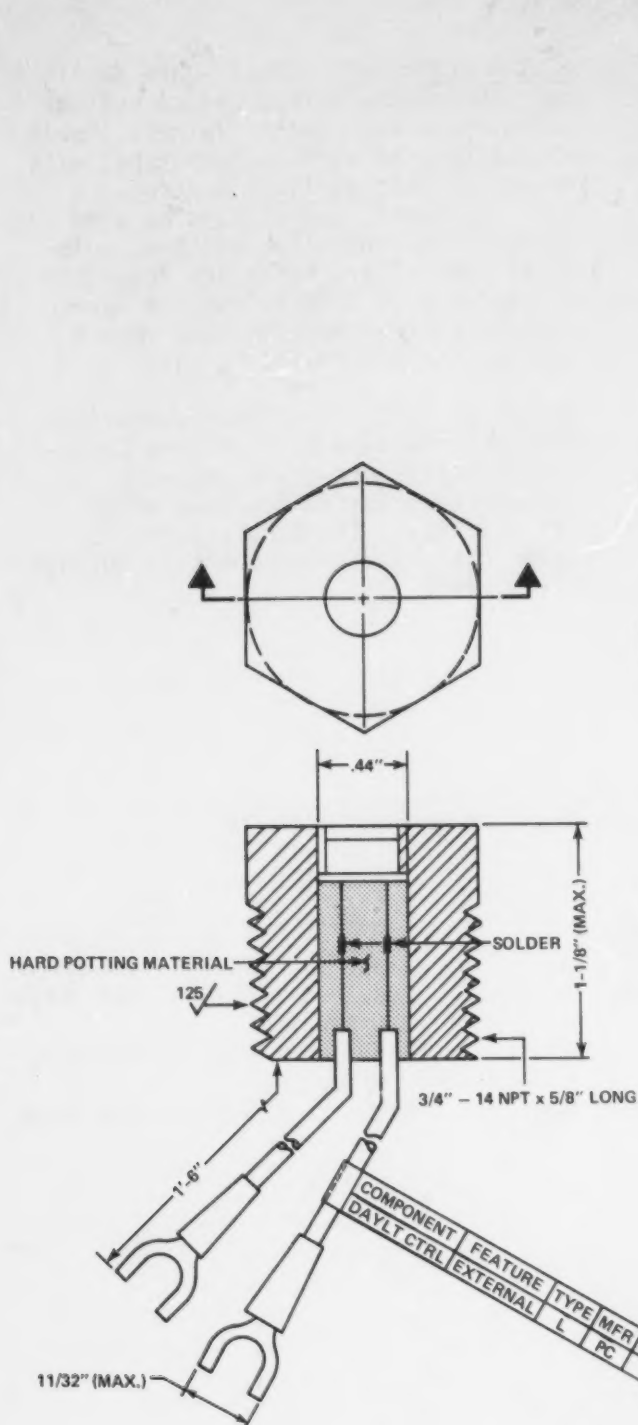


Figure 6-31. Dimensions of the externally mounted daylight control.

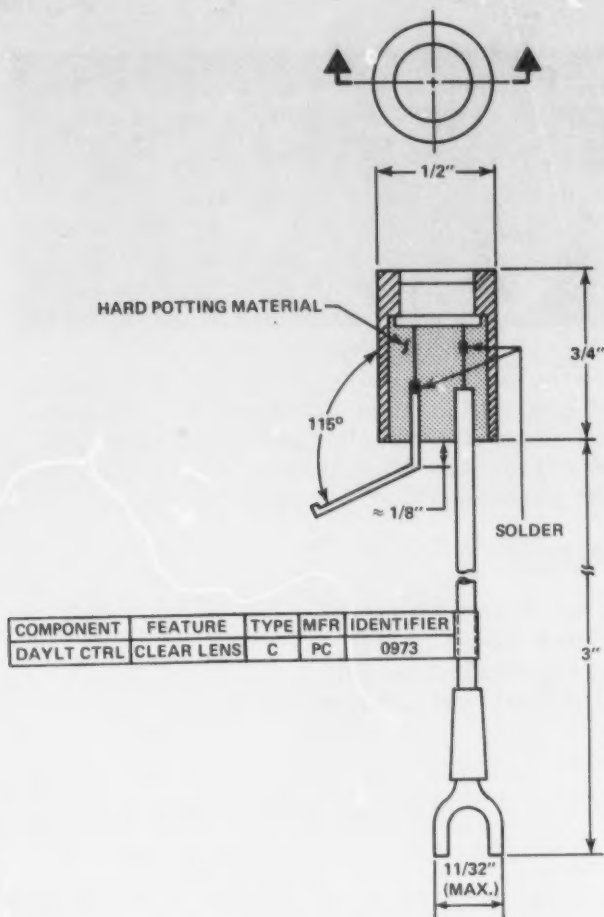


Figure 6-32. Dimensions of the flasher-mounted daylight control.

Data Sheet 6-D(5). (cont'd).

WIRING KIT (WK-681)



Function. The CG-6P lampchanger and CG-181 flasher are electrically connected by the three wires in this kit when used in the 155-, 200-, 250-, and 300-mm lanterns.

Dimensions. Dimensions of the single-conductor copper wire are as follows:

Wire size	#16 AWG
Lug size	#14 to 16 AWG
Wire length	6-1/2 ± 1/4 in.

Additional Data. Technical specifications for the WK-681 are given in G-EOE Purchase Description No. 261 of September 1972. The kit (NSN 6230-01-040-6848) is manufactured by Lear Siegler, Inc., and procurement is through E/GICP.

155-mm LANTERN



Function. The 155-mm lantern is the only standard lantern approved for use on buoys. A maximum omnidirectional range of 8 nmi can be obtained with standard 12 V equipment.

Features

- Fiberglass-reinforced, polyester-resin base with four 1/16-in. drain holes
- Replaceable clear, green, red, or yellow acrylic lenses
- No focusing adjustment (if the lamp-changer bracket is not deformed).

Dimensions. The Amerace and Tideland lanterns have approximately the same dimensions and weight. Drawing No. 120085, dated 19 February 1970, established the dimensional guidelines for manufacturers.

Related Equipment. The 155-mm lantern must be equipped with the following standard 12 Vdc equipment--12 Vdc lamps,

a CG-6P lampchanger, a CG-181 flasher, a daylight control, and the WK-681 wiring kit.

Additional Data. The following are applicable stock numbers for 155-mm lenses and lanterns:

155-mm lantern	
Clear lens	6210-01-043-0753
Green lens	6210-01-029-4173
Red lens	6210-01-029-4174
Yellow lens	6210-01-GG0-0859
Lens only	
Tideland clear	6210-01-035-0417
Tideland green	6210-01-035-0418
Tideland red	6210-01-095-5826
Tideland yellow	6210-01-GG0-0860
Amerace clear	6210-01-043-0753
Amerace green	6210-01-035-0416
Amerace red	6210-01-039-8420
Amerace yellow	6210-01-GG0-0861

Technical specifications are listed in G-EOE Purchase Description No. 205B of March 1972. Manufacturers are the Tideland Signal Corp. and the Amerace Corp. The 155-mm lantern and lenses can be procured through E/GICP. Labeled parts shown in Figure 6-33 may be procured from Amerace Corp. via term contract. Labeled parts shown in Figure 6-35 may be procured from Tideland Signal Corp. via term contract.

The Tideland lens can be used as a *temporary* replacement on the Amerace base by using the Amerace hinge pin and the three Amerace captive screws and washers. This combination should be eliminated as soon as practical.

Additional Data (cont'd)

Table 6-13
155-mm Lens Characteristics for 12 V Lamps

Lamp current rating (A)	0.25	0.55	0.77	1.15	2.03
Mean horizontal intensity with clear lens (cd)	50	120	180	260	500
Vertical divergence (degrees)					
50% of peak intensity	± 1.7	± 2.1	± 2.6	± 2.6	± 2.5
15% of peak intensity	± 2.2	± 3.7	± 3.7	± 3.9	± 3.8
Nominal range with clear lens (nmi)					
At peak intensity	4	6	6	7	8
15% of peak intensity	2	3	4	4	5
Nominal range with red or green lens (nmi)					
At peak intensity	3	4	4	5	6
15% of peak intensity	1	2	2	3	3
Nominal range with yellow lens (nmi)					
At peak intensity	4	5	6	6	8
15% of peak intensity	2	3	3	4	5

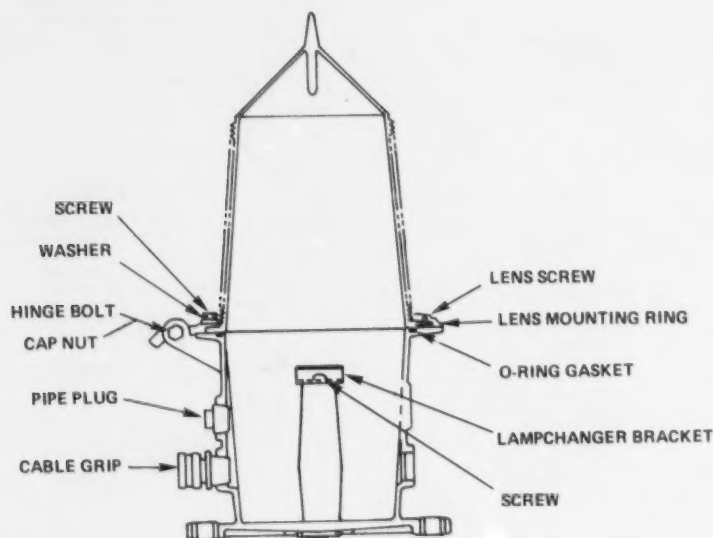


Figure 6-33. Amerace lantern parts.

Data Sheet 6-D(7). (cont'd).

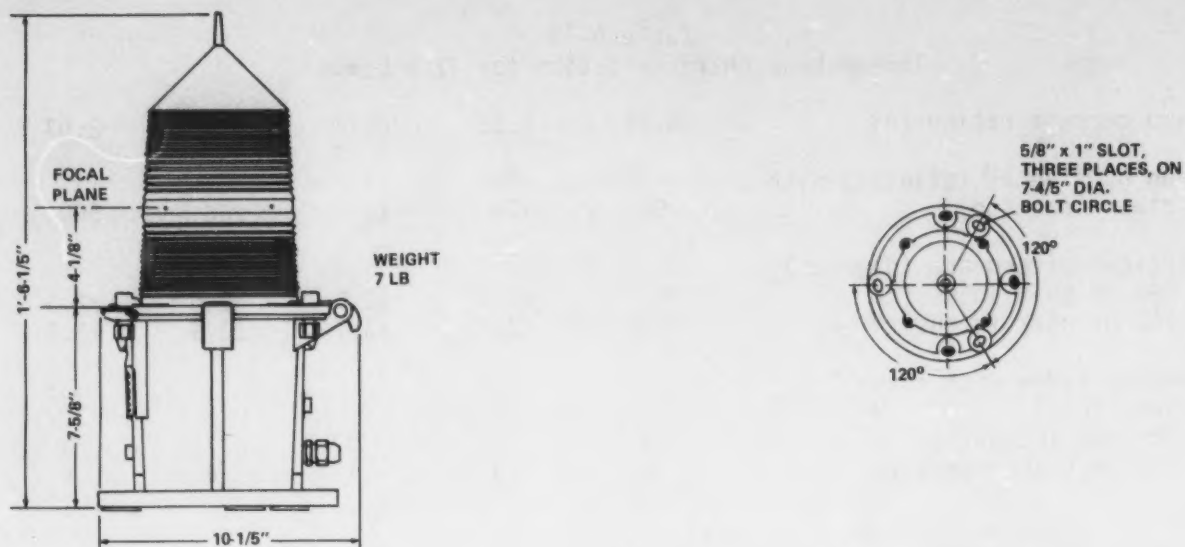


Figure 6-34. Dimensions of the Tideland 155-mm lantern.

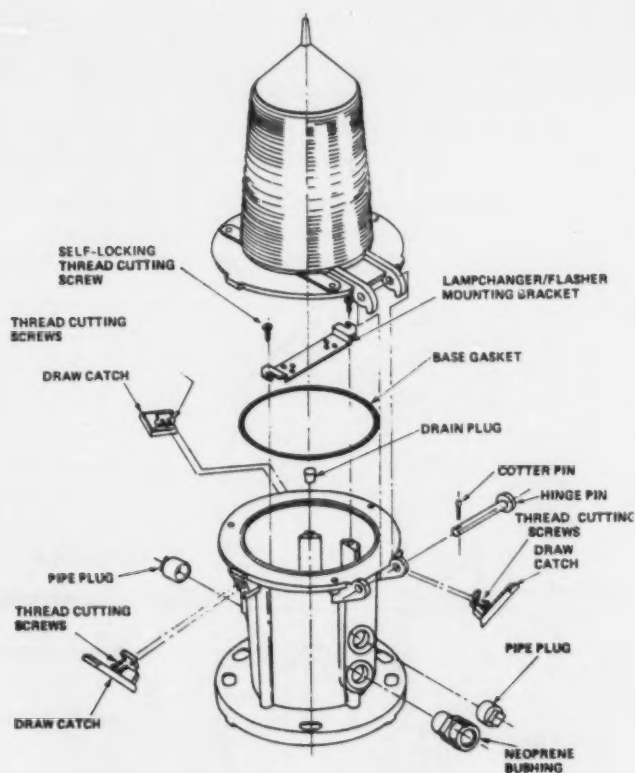


Figure 6-35. Tideland lantern parts.

Data Sheet 6-D(7). (cont'd).

250-mm LANTERN



Features

- Optional color sectors and pencil beams
- Requires precision focusing and leveling
- Requires azimuth sighting of beams and sectors
- Replaceable clear, green, red, or yellow acrylic lens covers
- Ventilated version for use with 120 Vac lamps can dissipate 200 W of heat continuously
- Unventilated version can dissipate 75 W of heat continuously
- Aluminum base with four 1/16-in. drain holes.

Function. The 250-mm lantern is used only on stable platforms. It shall not be used on buoys and single pile beacon structures located in the water. Omni-directional nominal ranges up to 9 nmi can be obtained with the standard 12 V equipment.

Related Equipment. The following standard 12 Vac equipment is required for use with the 250-mm lantern--12 Vdc lamps, CG-6P lampchanger, CG-181 flasher, type C or R daylight control, WK-681 wiring kit, and a focus fixture.

Table 6-14
250-mm Lens Characteristics for 12 V Lamps

Lamp current rating (A)	0.25	0.55	0.77	1.15	2.03	3.05
Mean horizontal intensity with clear lens cover (cd)	70	180	270	400	770	1050
Vertical divergence (degrees)						
50% of peak intensity	±1.0	±1.1	±1.4	±1.6	±1.5	±1.7
15% of peak intensity	±1.5	±1.7	±1.9	±2.2	±2.0	±2.3
Nominal range with clear lens cover (nmi)						
At peak intensity	5	6	7	7	9	9
15% of peak intensity	3	4	4	5	6	6
Nominal range with red or green lens cover (nmi)						
At peak intensity	4	5	5	6	7	7
15% of peak intensity	2	3	3	3	4	5
Nominal range with yellow lens cover (nmi)						
At peak intensity	4	6	6	7	8	9
15% of peak intensity	2	3	4	4	5	6

Data Sheet 6-D(8). 250-mm lantern.

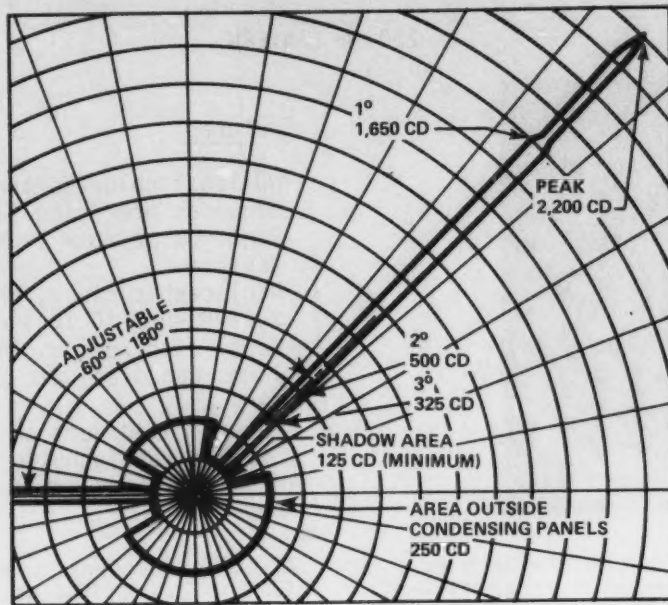


Figure 6-36. Horizontal intensity distribution of a 250-mm lens with two condensing panels and a 12 Vdc, 0.77 A lamp.

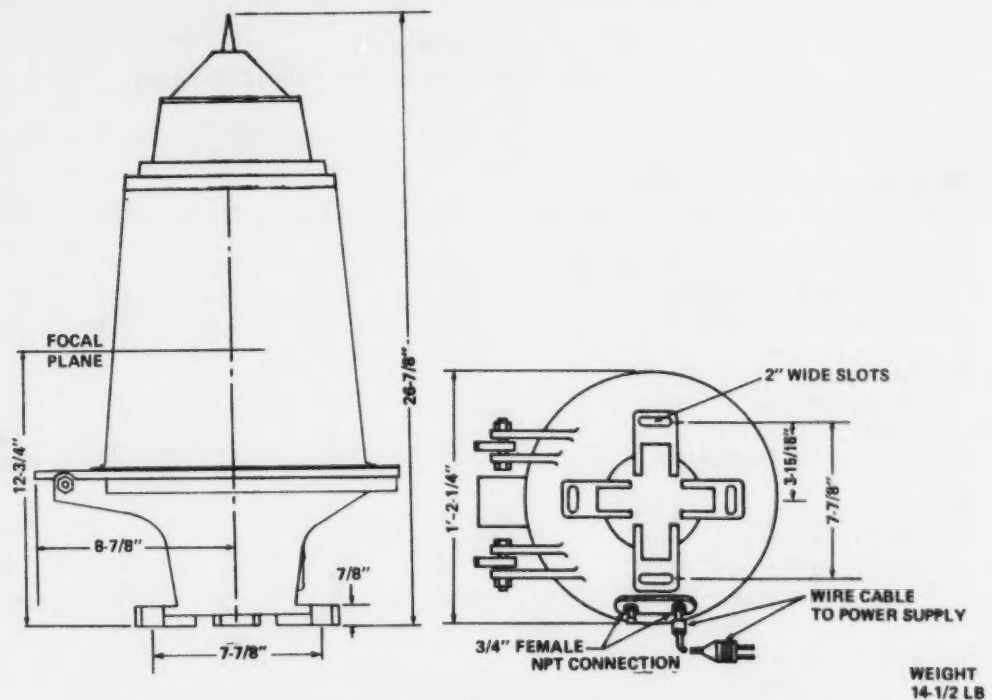


Figure 6-37. Dimensions of the 250-mm lantern.

Data Sheet 6-D(8). (cont'd).

TABLE 6-14(a)

250-mm LENS CHARACTERISTICS FOR 120 Vac, 250-W LAMP

Lamp current rating (A)	2.04
Mean horizontal intensity with clear lens cover (cd)	4440
Vertical divergence (degrees)	
50% of peak intensity	±3.2
15% of peak intensity	±4.5
Nominal range with yellow or clear lens cover (nmi)	
at peak intensity	12
15% of peak intensity	8
Nominal range with red or green lens cover (nmi)	
at peak intensity	10
15% of peak intensity	6
Peak intensity with condensing panel (cd)	41,400
Horizontal divergence at 50% of peak intensity (degrees)	±1.5
Nominal range with yellow or clear lens cover at peak intensity (nmi)	17
Nominal range with red or green lens cover at peak intensity (nmi)	14

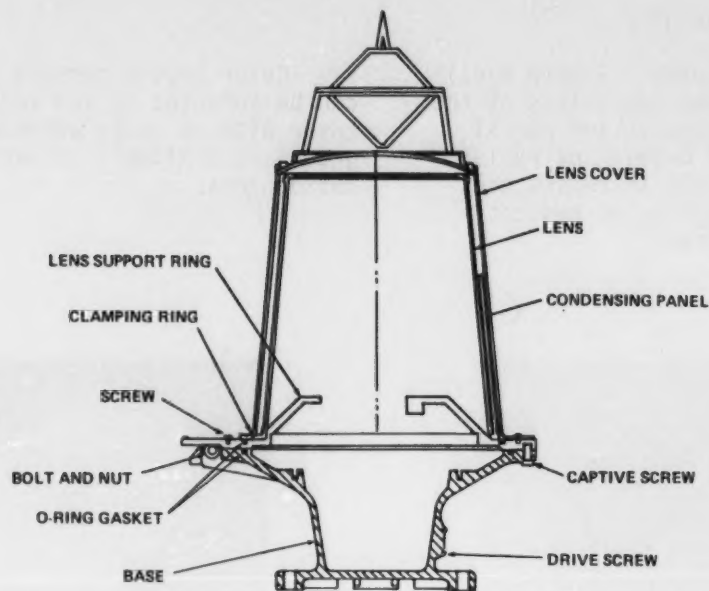


Figure 6-38. Parts of the 250-mm lantern available from Amerace Corp.

Additional Data. The Amerace Corp. is the manufacturer and procurement is through Amerace by term contract.

The lens cover (Figure 6-39) protects the lens and maintains a high

candlepower output. It can provide a colored beam and colored sectors in the beam, and has a integral bird spike.

The drum lens (Figure 6-40) is open at the top to permit circulation of air.

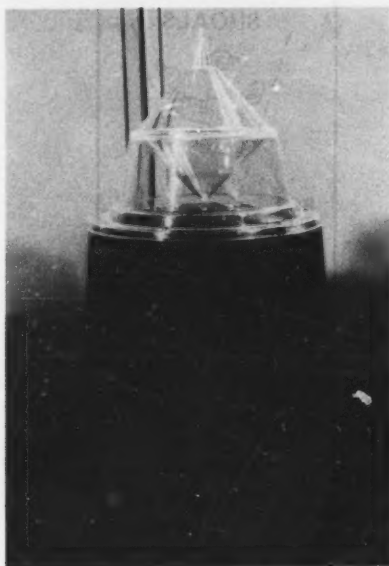


Figure 6-39. 250-mm lens cover.

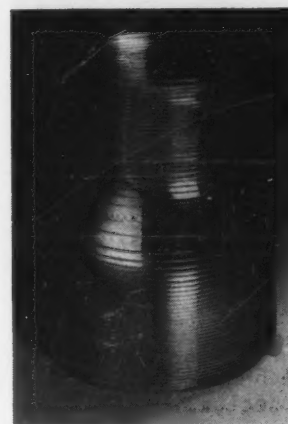


Figure 6-40. 250-mm drum lens.

Data Sheet 6-D(8). (cont'd).

Additional Data (cont'd)

The condensing panel (Figure 6-41) is 60 degrees wide and two-thirds of the lens' height. It produces the pencil beam shown in Figure 6-36. The reflex reflector (Figure 6-41) increases the intensity of the light by 30 percent over a 60 degree sector.

Color sector screens (Figure 6-42) can be cemented to the inside of a clear cover with an epoxy adhesive. Red or green are available in sectors from 5 to 355 degrees.

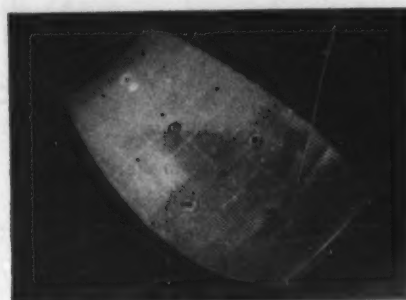
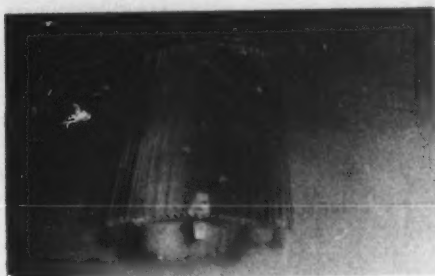


Figure 6-41. Condensing panel and reflex reflector.

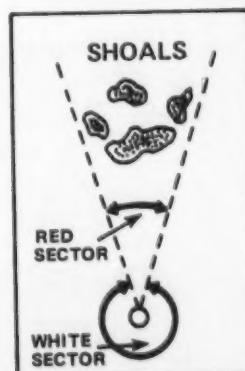
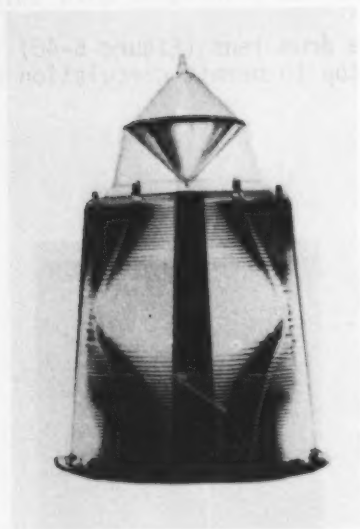


Figure 6-42. Colored screen on the lens cover (e.g., a red screen projects a red sector).

Three 3/4-in. long spacers are provided with the mounting bracket shown in Figure 6-43.



Figure 6-43. Lampchanger and flasher mounting bracket.



Figure 6-44. Bird guard.

The ventilated 250-mm lantern (Figure 6-45) shall be used with 120 Vac lamps when the average lamp power exceeds 75 W.

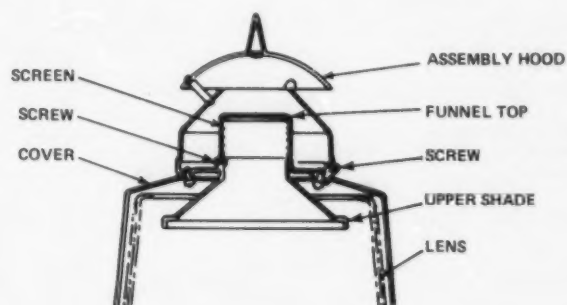


Figure 6-45. Ventilation hood for 250-mm lens cover.

Data Sheet 6-D(8). (cont'd).

300-mm LANTERN



Function. The 300-mm lantern is used only on stable platforms. It shall not be used on buoys and single pile beacon structures located in the water. Omni-directional nominal ranges up to 10 nmi

can be obtained with the standard 12 V equipment.

Features

- Requires precision focusing and leveling
- Replaceable clear, green, red, or yellow acrylic lens
- Can dissipate 250 W of heat continuously
- Plastic base with four 1/16 in. drain holes.

Related Equipment. The 300-mm lantern must be equipped with the following standard 12 Vdc equipment--12 Vdc lamps, CG-6P lampchanger, CG-181 flasher, type C or R daylight control, WK-681 wiring kit, and the focus fixture and focus lens, which must be used to focus the lantern.

Additional Data. Tideland Signal Corp. is the manufacturer and procurement is through Tideland by term contract.

The focus lens (Figure 6-48) must be used with the 300-mm lens. It cannot be used to focus other lanterns.

Table 6-15
300-mm Lens Characteristics for 12 V Lamps

Lamp current rating (A)	0.25	0.55	0.77	1.15	2.03	3.05
Mean horizontal intensity with clear lens (cd)	100	260	400	550	1,050	1,500
Vertical divergence (degrees)						
50% of peak intensity	±0.8	±0.89	±1.25			±1.42
15% of peak intensity	±1.1	±1.4	±1.75			±1.76
Nominal range with clear lens (nmi)						
At peak intensity	5	7	8	8	9	10
15% of peak intensity	3	4	5	5	6	7
Nominal range with red or green lens (nmi)						
At peak intensity	4	5	6	6	7	8
15% of peak intensity	2	3	3	3	4	5
Nominal range with yellow lens (nmi)						
At peak intensity	5	6	7	7	9	9
15% of peak intensity	3	4	4	5	5	6

Data Sheet 6-D(9). 300-mm lantern.

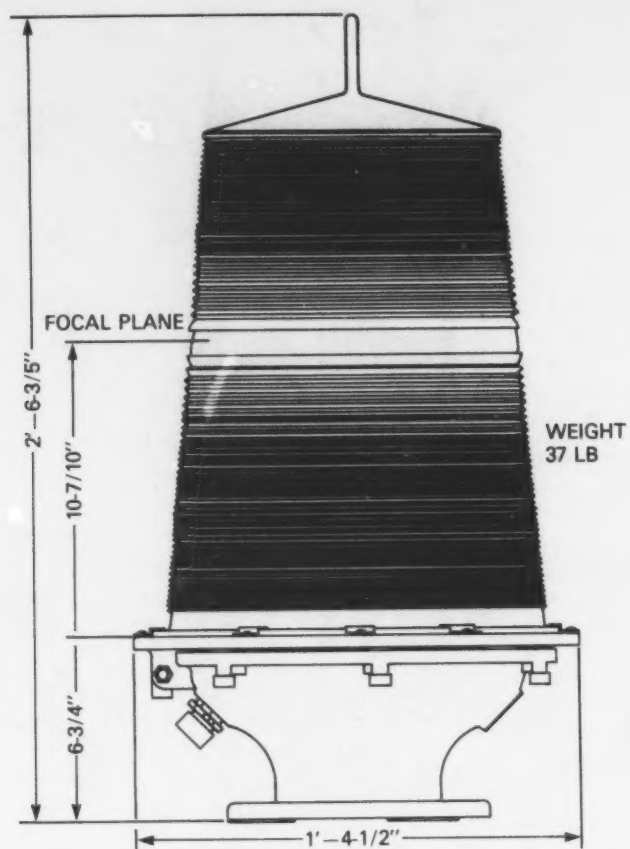
TABLE 6-15(a)

300-mm LENS CHARACTERISTICS FOR 120 Vac, 250-W LAMP

Lamp current rating (A)	2.04
Mean horizontal intensity with clear lens (cd)	5760
Vertical divergence (degrees)	
50% of peak intensity	± 2.4
15% of peak intensity	± 3.2
Nominal range with clear lens (nmi)	
at peak intensity	13
at 15% of peak intensity	9
Nominal range with red or green lens (nmi)	
at peak intensity	10
at 15% of peak intensity	7
Nominal range with yellow lens (nmi)	
at peak intensity	12
at 15% of peak intensity	8

-9-

11



3/4" DIA. HOLES,
SIX PLACES, ON 7-3/4"
DIA. BOLT CIRCLE

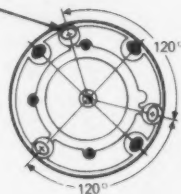


Figure 6-46. Dimensions of the 300-mm lantern.

Data Sheet 6-D(9). (cont'd).

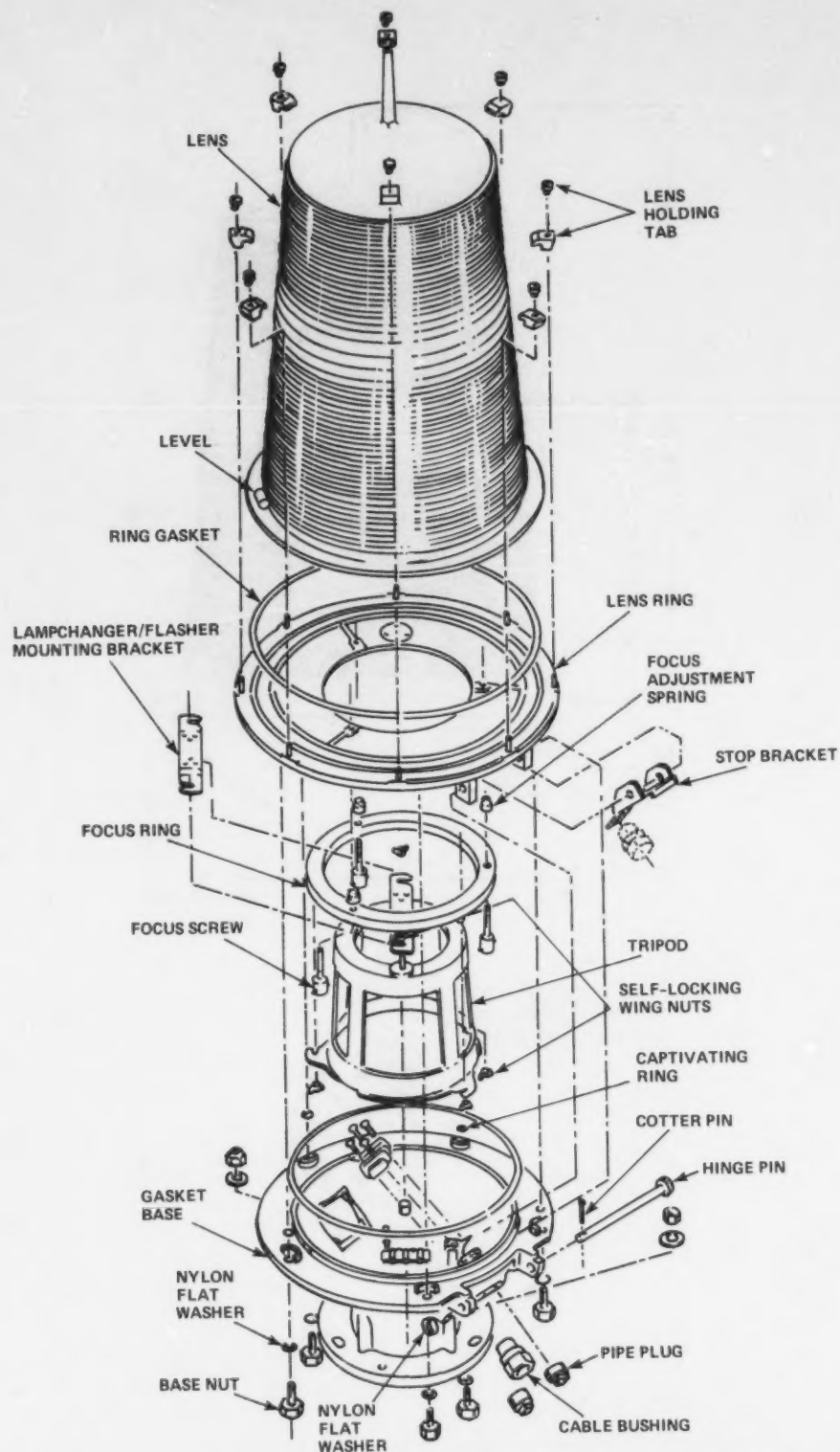


Figure 6-47. Parts of the 300-mm lantern available from Tideland Signal Corp.
Data Sheet 6-D(9). (cont'd).

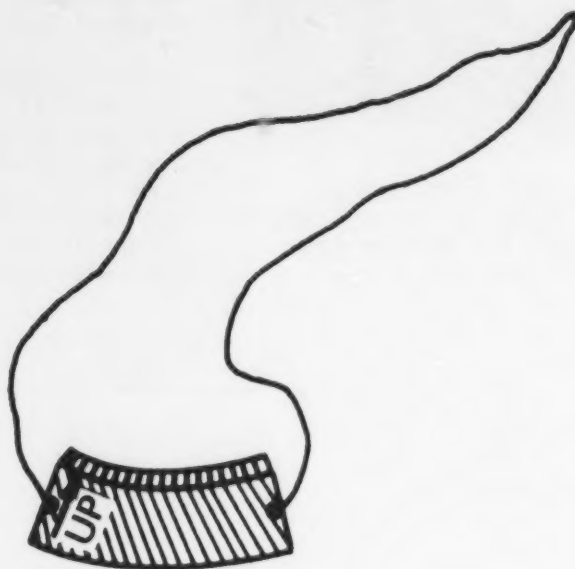
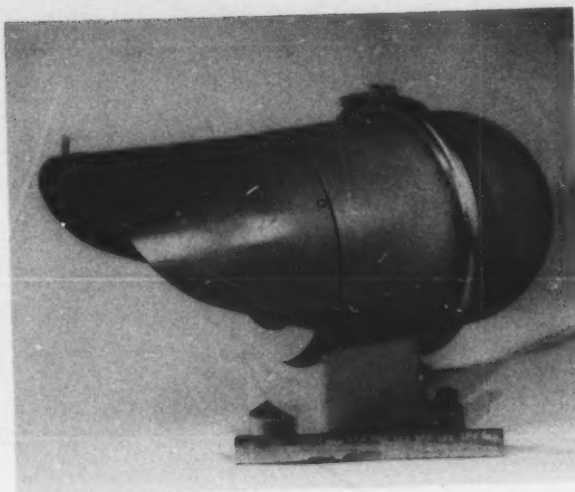


Figure 6-48. Focus lens.

Data Sheet 6-D(9). (cont'd).

FA-240 RANGE LANTERN

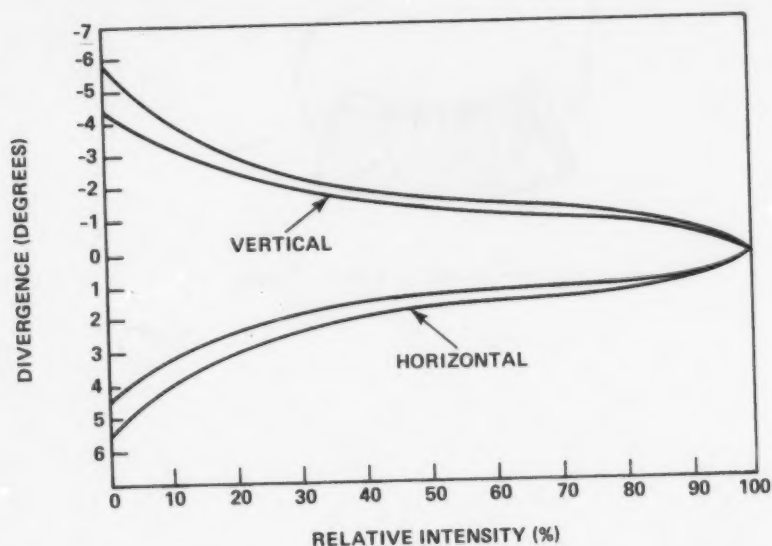


Function. This lantern emits a high-intensity, pencil beam. It is used only on two-station ranges and must be installed on a stable platform.

Features

- Fiberglass base and cover
- Aluminum hood
- Vacuum-tight seal
- Requires precision leveling and sighting
- Replaceable clear, green, ~~or~~ red or yellow acrylic lenses
- Selection of horizontal beam divergences
- Requires skillful shop focusing with hand-picked lamps.

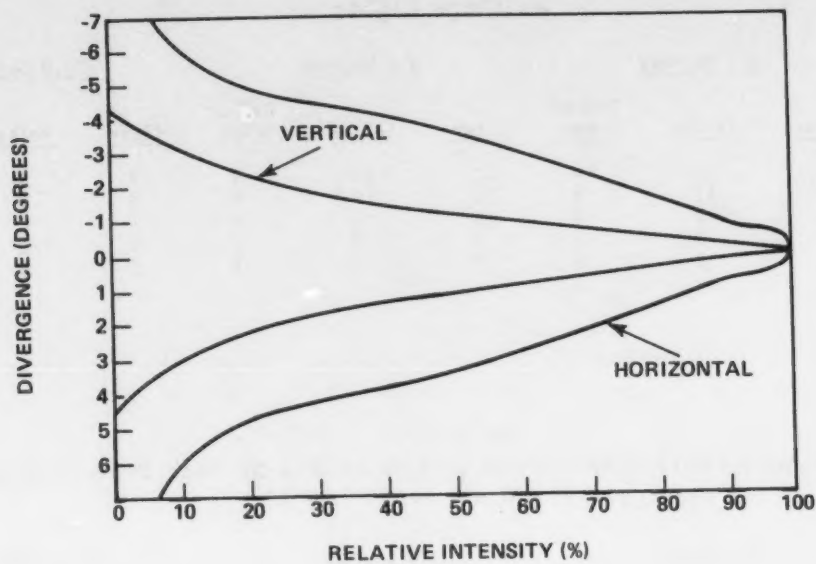
Related Equipment. Standard 12 V equipment must be used in the FA-240 lantern. A type L daylight control must be used. The CG-6P lampchanger can be a C-R Development Corp. model with a gray frame, or the Vap-Air Corp. model, which is no longer in the supply system. The older C-R Development model with a reddish



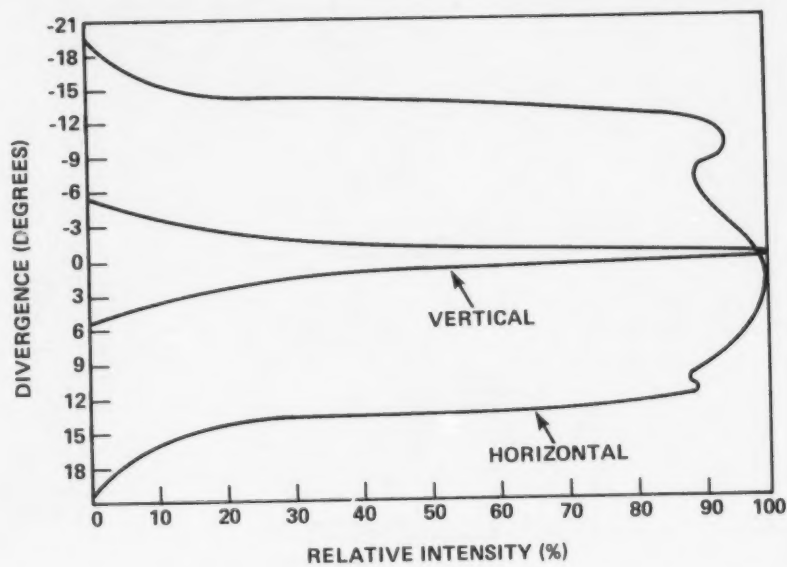
(a) 3.5-degree spread lens.

Figure 6-49. Typical beam divergences of FA-240 lenses with 12 V lamps.

Data Sheet 6-D(10). FA-240 range lantern.



(b) 8-degree spread lens.



(c) 30-degree spread lens.

Figure 6-49. (cont'd)

Data Sheet 6-D(10). (cont'd).

Table 6-16.
Peak Nominal Ranges (nmi) with Spread Lenses for Applications
as Range Lights

Lamp Current Rating (A)	3.5 Degrees			8.0 Degrees			30.0 Degrees		
	Clear	Yellow	Red or Green	Clear	Yellow	Red or Green	Clear	Yellow	Red or Green
2.03	13	13	10	12	11	9	9	9	7
1.15	12	11	9	10	10	8	8	7	6
0.77	11	10	9	10	9	8	7	7	5
0.55	10	9	8	9	8	6	6	6	4
0.25	8	8	6	7	7	5	5	5	3

Table 6-17
Nominal Ranges (nmi) with Spread Lenses at 15% of Peak Beam Intensity
for Application as Range Lights

Lamp Current Rating (A)	3.5 Degrees			8.0 Degrees			30.0 Degrees		
	Clear	Yellow	Red or Green	Clear	Yellow	Red or Green	Clear	Yellow	Red or Green
2.03	9	9	7	8	8	6	6	6	4
1.15	8	7	6	7	7	5	5	4	3
0.77	7	7	5	7	6	4	4	4	3
0.55	6	6	4	6	5	4	4	3	2
0.25	5	5	3	4	4	3	3	2	2

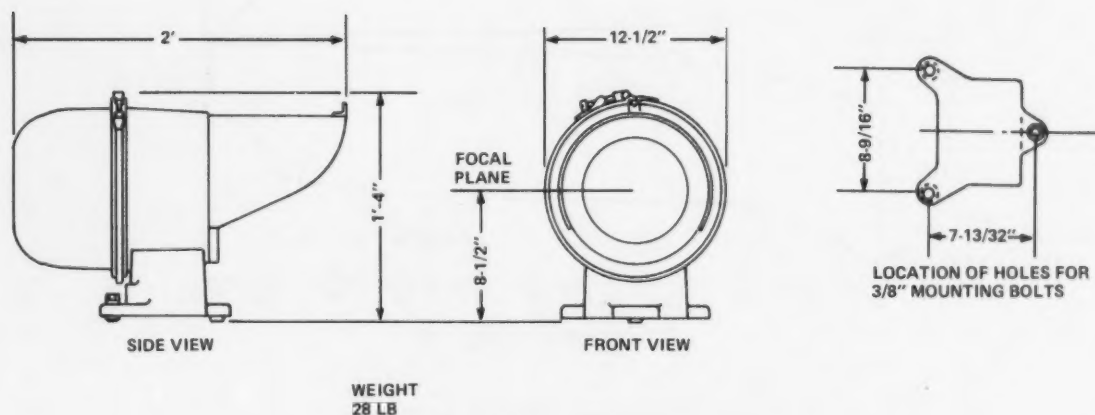
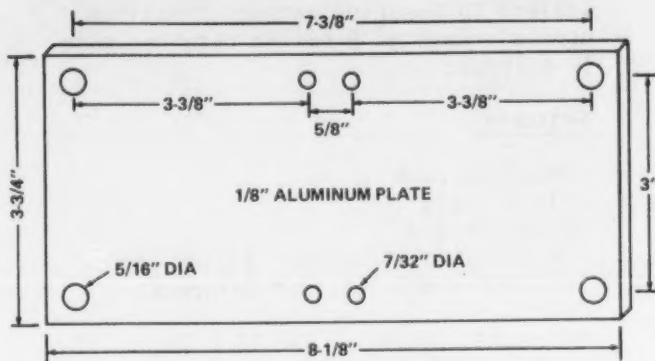


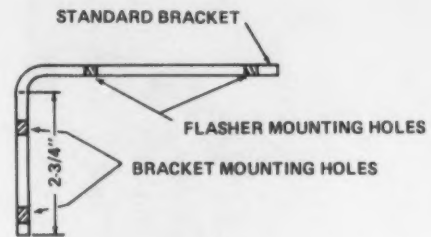
Figure 6-50. Dimensions of the FA-240 lantern.

Data Sheet 6-D(10). (cont'd).

Related Equipment (cont'd)



(a) Lampchanger bracket.



(b) Flasher bracket.

Figure 6-51. Lampchanger and flasher brackets.

frame cannot be used in the FA-240 lantern.

Additional Data. Procurement is through Automatic Power, Inc., by term contract. Lampchanger and flasher brackets are

supplied with each FA-240 lantern and make it compatible with the standard 12 V equipment. Other brackets should not be used. Replacement parts for the FA-240 lantern are available from Automatic Power, Inc.

200-mm LANTERN



Function. The 200-mm lantern provides an omnidirectional light on buoys and piles where light-to-moderate icing is expected and on exposed bars and jetties

subject to breaking water. A maximum nominal range of 8 nmi is obtained with 12 V lamps.

Features

- Aluminum base
- Glass lens
- Aluminum lid
- No focusing adjustment if the lamp-changer bracket is not deformed.

Related Equipment. The 12 V lamps, CG-6P lampchanger, CG-181 flasher, WK-681 wire kit, and a type C or B daylight control are standard equipment for use with the 200-mm lantern.

Additional Data. The 200-mm lantern and parts are available from a term contract with Automatic Power, Inc. The only parts that are compatible with the old style 200-mm (pictured above) are the lens and gaskets.

Table 6-18
200-mm Lens Characteristics for 12 V Lamps

Lamp current rating (A)	0.25	0.55	0.77	1.15	2.03	3.05
Mean horizontal intensity with clear lens (cd)	30	80	120	180	380	520
Vertical divergence (degrees)						
50% of peak intensity		±2.7	±2.2			
15% of peak intensity		±4.0	±3.8			
Nominal range with clear lens (nmi)						
At peak intensity	4	5	6	6	8	8
15% of peak intensity	2	3	3	4	5	5
Nominal range with red or green lens (nmi)						
At peak intensity	2	3	4	4	5	5
15% of peak intensity	1	1.5	2	2	3	3
Nominal range with yellow lens (nmi)						
At peak intensity	3	4	5	5	6	7
15% of peak intensity	1	2	2	3	4	4

Data Sheet 6-D(11). 200-mm lantern.

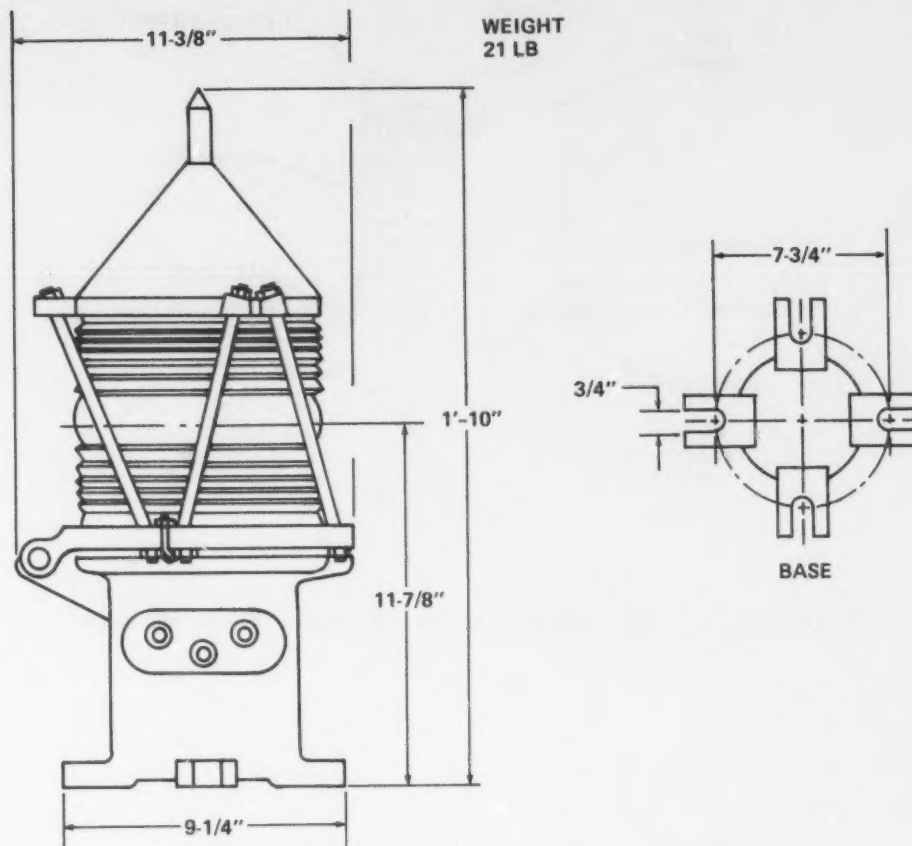


Figure 6-52. Dimensions of the 200-mm lantern.

Data Sheet 6-D(11). (cont'd).

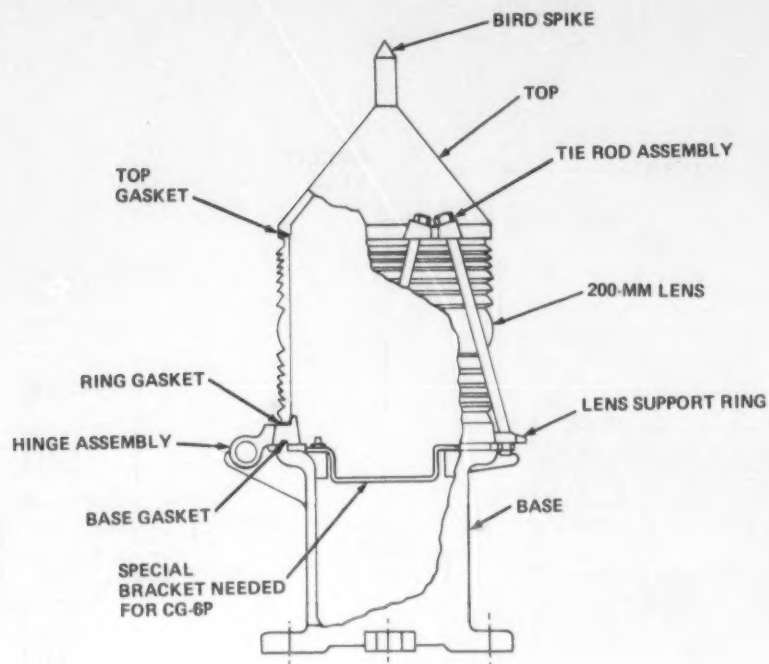


Figure 6-53. Replacement parts for the 200-mm lantern.

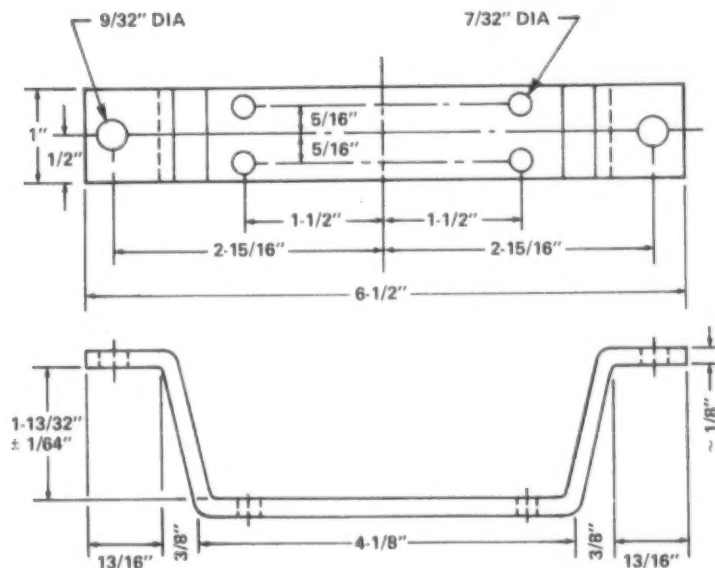


Figure 6-54. 200-mm lantern bracket.

Data Sheet 6-D(11). (cont'd).

190-mm LANTERN



Function. The 190-mm rotating lantern is used only on structures not subjected to noticeable vibrations. This lantern is required for use where only battery power is available, and when the required nominal range for a white or colored light exceeds 8 or 6 nmi, respectively.

Features

- Requires precision focusing and leveling
- Replaceable clear, green, or red lens cover
- Can dissipate 60 W of heat continuously
- Requires relamping every 230 days
- Selection of rpm and number of flash panels (up to six)
- Requires a vibration-free platform
- Cannot be used with color sectors in the lens cover.
- Replaces the DCB-10 rotating beacon

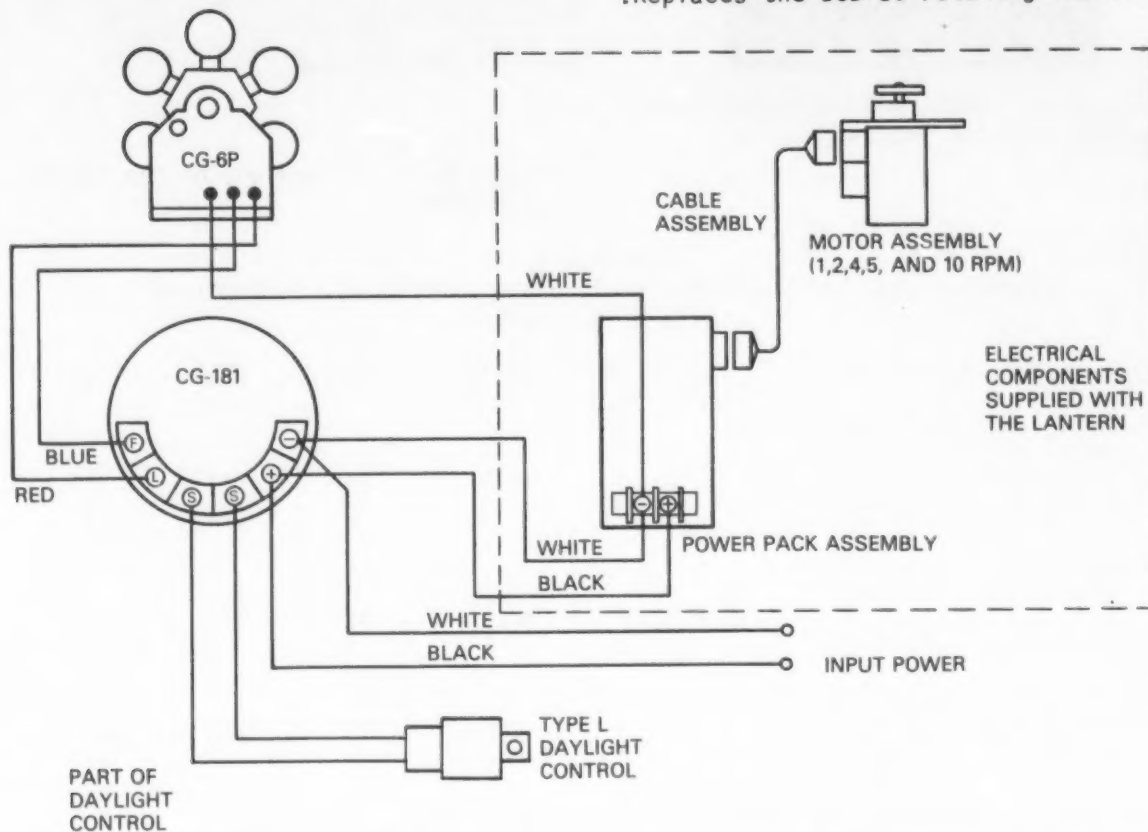


Figure 6-55. Electrical circuit of the 190-mm lantern.

Data Sheet 6-D(12). 190-mm lantern.

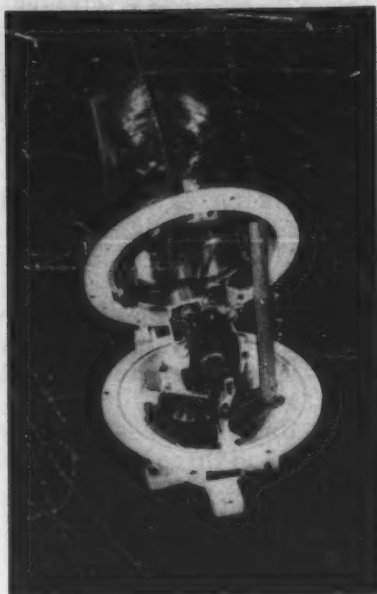


Figure 6-56. Motor and turntable drive assembly of the 190-mm lantern.

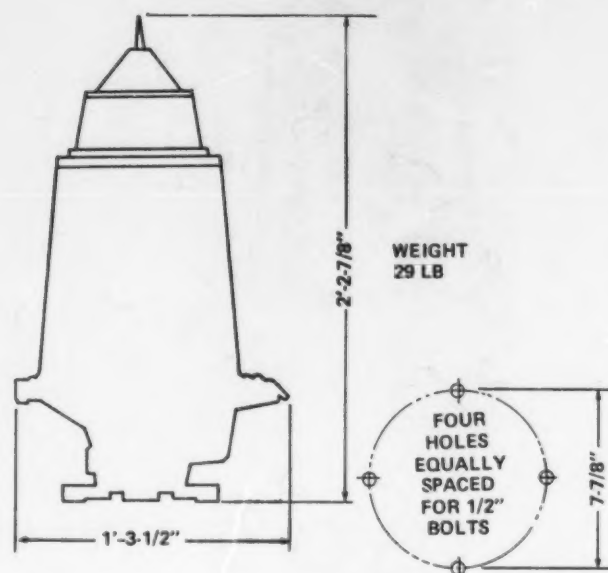


Figure 6-57. Dimensions of the 190-mm lantern.

Table 6-19
Characteristics of the White Pencil Beams Emittted by a 190-mm Lens
and a 12 V Lamp

Lamp current rating (A)	0.55	0.77	1.15	2.03	3.05
Nominal range (nmi) with a clear cover at 1 rpm					
At peak intensity	12	13	14	15	16
15% of peak intensity	8	9	10	11	12
Nominal range (nmi) with a color cover at 1 rpm					
At peak intensity	9	11	11	13	13
15% of peak intensity	6	7	8	9	9
Vertical divergence (degrees)					
50% of peak intensity	1.2	1.4	1.5	1.6	2.0
15% of peak intensity	1.8	1.6	1.9	2.1	2.4
Horizontal divergence (degrees)					
50% of peak intensity	0.19	0.24	0.24	0.3	0.32
15% of peak intensity	0.42	0.50	0.50	0.7	0.7

Data Sheet 6-D(12). (cont'd).

Table 6-20
Nominal Range and Apparent Flash Length Displayed by a 190-mm Lantern
Emitting White Light

<u>Lamp</u>	<u>Revolutions per Minute</u>						Fixed
	1	2	3	4	5	10	
12 V, 0.55 A							
Nominal Range (nmi)	12	11	10	10	9	8	15
Flash Length (sec)	.12	.08	.06	.04	.04	.02	
12 V, 0.77 A							
Nominal Range (nmi)	13	12	11	11	10	9	16
Flash Length (sec)	.14	.08	.06	.05	.04	.02	
12 V, 1.15 A							
Nominal Range (nmi)	14	13	12	11	11	10	17
Flash Length (sec)	.14	.09	.06	.05	.04	.02	
12 V, 2.03 A							
Nominal Range (nmi)	15	14	14	13	13	12	18
Flash Length (sec)	.17	.10	.08	.06	.05	.03	
12 V, 3.05 A							
Nominal Range (nmi)	16	15	14	14	13	12	19
Flash Length (sec)	.18	.11	.08	.07	.06	.03	

Table 6-21
Nominal Range and Apparent Flash Length Displayed by a 190-mm Lantern
Emitting Colored Light

<u>Lamp</u>	<u>Revolutions per Minute</u>						Fixed
	1	2	3	4	5	10	
12 V, 0.55 A							
Nominal Range (nmi)	9	9	8	8	7	6	13
Flash Length (sec)	.12	.08	.06	.04	.04	.02	
12 V, 0.77 A							
Nominal Range (nmi)	11	10	9	9	8	7	14
Flash Length (sec)	.14	.08	.06	.05	.04	.02	
12 V, 1.15 A							
Nominal Range (nmi)	11	10	10	9	9	8	14
Flash Length (sec)	.14	.09	.06	.05	.04	.02	
12 V, 2.03 A							
Nominal Range (nmi)	13	12	11	11	11	9	16
Flash Length (sec)	.17	.10	.08	.06	.05	.03	
12 V, 3.05 A							
Nominal Range (nmi)	13	12	12	11	11	10	16
Flash Length (sec)	.18	.11	.08	.07	.06	.03	

Data Sheet 6-D(12). (cont'd).

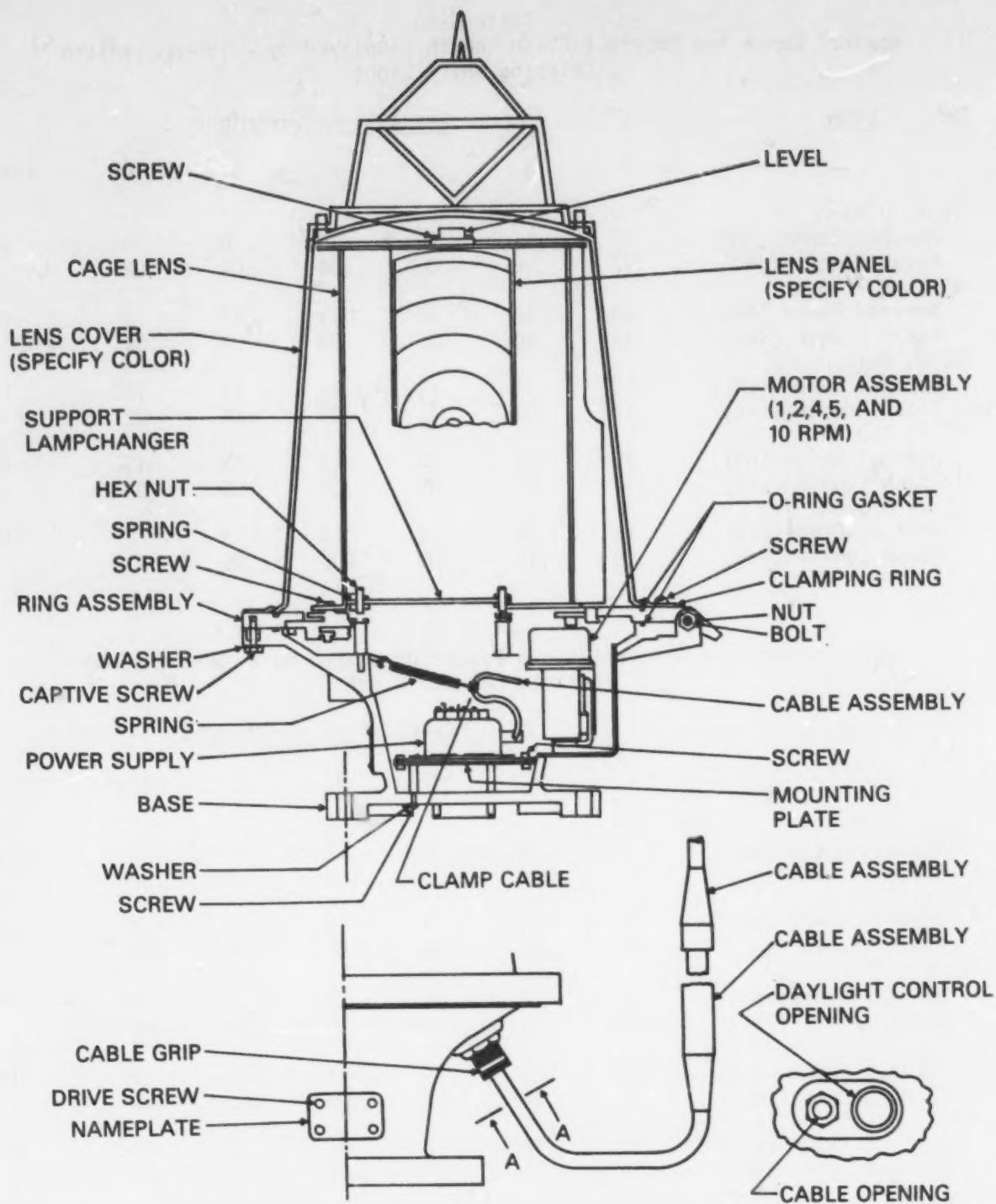


Figure 6-58. 190-mm lantern--parts supplied by Amerace Corp.

Data Sheet 6-D(12). (cont'd.)

Related Equipment. The 190-mm lantern must be equipped with 12 V lamps, the CG-6P lampchanger, the CG-181 flasher, and a type L daylight control.

Additional Data. Procurement of the 190-mm lantern is through the manufacturer, Amerace Corp.

In 190-mm lanterns procured before July 1977 a rolamite assembly (Figure 6-59a) provides spring tension between the friction drive wheel and the brass lens ring.

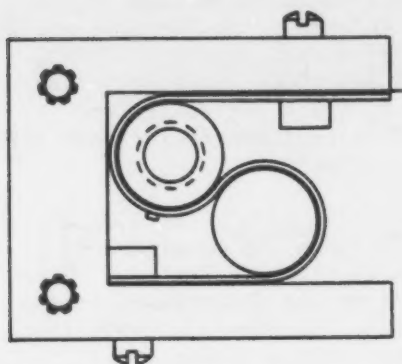


Figure 6-59a. Rolamite assembly for 190-mm lantern.

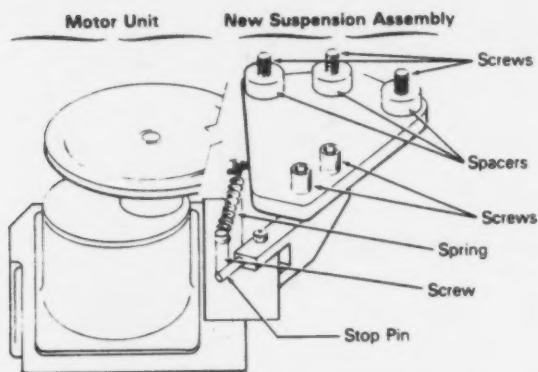


Figure 6-59b. Spring assembly for 190-mm lantern.

The spring assembly (Figure 6-59b) replaces the rolamite assembly in 190-mm lanterns procured after July 1977. The rolamite assembly can be replaced by the spring assembly with a screwdriver.

The flash characteristic of the lantern depends on the beam pattern (Figure 6-60) and the rotation speed selected. The rotation speed of the lantern stays within 6 percent of the rated rpm for motor voltages above 8.0. The motor draws 0.86 Ah/day at 70°F and 1.13 Ah/day at -20°F when 12 V is supplied. The optic rotates 24 hr/day.

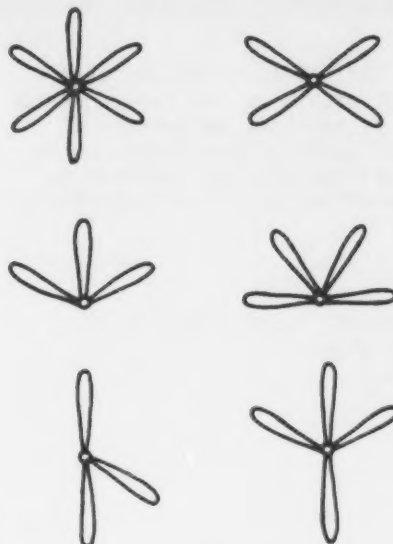
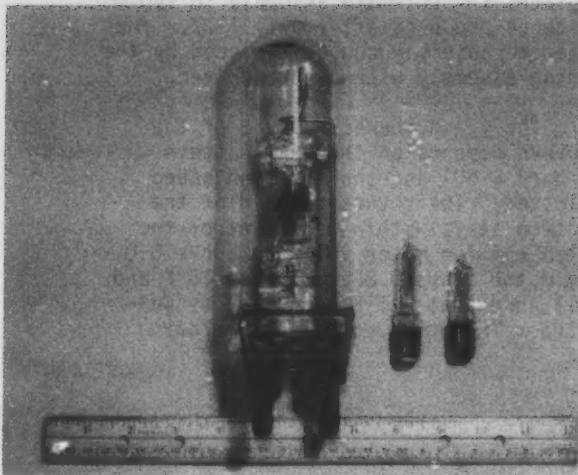


Figure 6-60. Possible beam patterns for a 190-mm lantern.

Data Sheet 6-D(12). (cont'd).



Function. The 120 Vac lamps are used when a light with a nominal range greater than 9 nmi is required and commercial power is available. These lamps can be used in fixed and rotating lanterns to generate pencil beams and omnidirectional fan beams.

Features

.Omnidirectional light output in the horizontal plane

- .CC-8 incandescent filament
- .Tungsten-Halogen for long life expectancy and high lumen maintenance
- .Quartz bulbs
- .Large filaments for easy focusing and large vertical divergences

Related Equipment. Two companies, Crouse-Hind and Carlisle and Finch, make two-place, horizontal-swing lampchangers for the 1000W lamp. The 1000W lamp can be used in the DCB-24 and DCB-224. The Tideland 120Vac, four place lamp changer is used with the 250W lamp in the 250 mm and 300 mm lanterns and with the 150W lamp in the FA-251-AC. The 250W and 1000W lamps are flashed by the AC flash controller and the audio-visual controller described in chapter 8.

Additional Data. The 150, 250, and 1000W lamps are manufactured by the General Electric Company. Purchase the 250W and 1000W lamps through E/GICP. Purchase the 150W lamp off of GSA contract number GS-07S-10360.

Table 6-22

120 Vac Lamp Specifications and Stock Numbers

Lamp current rating (a)	8.33	1.25	2.08
Power (W)	1,000	150	250
Clear bulb	T-20	T-4	T-4
Base type	mogul bipost	DC bayonet	DC bayonet
Minimum on time (sec)	0.62	0.30	0.30
Life expectancy (hr)	3,000	2,000	2,000
Lumen output (lm)	17,200	2,600	4,700
NSN	6240-00-905-7512	6240-01-082-8797	6240-00-427-1067

Data Sheet 6-D(13). 120 Vac Lamps.

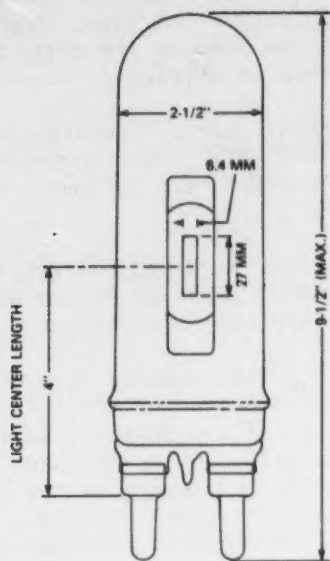


Figure 6-61(a). Dimensions of the 1000 W Lamp with Mogul Bipost Base.

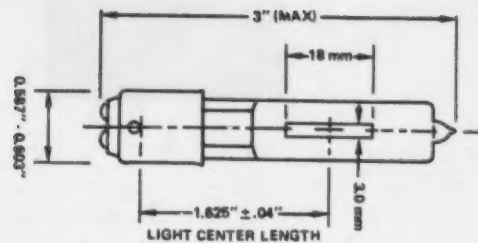


Figure 6-61(b). Dimensions of the 250 W Lamp with DC Bayonet Base.

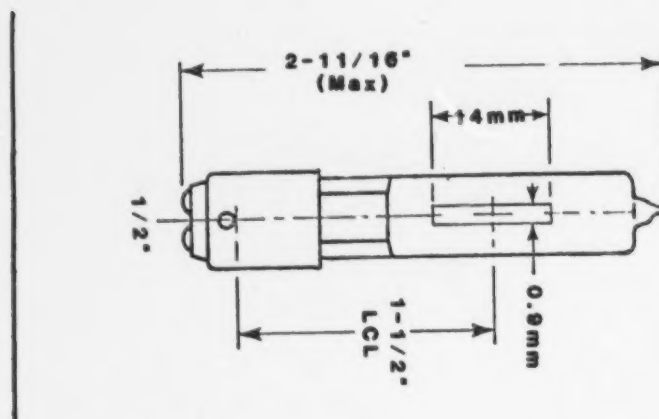


Figure 6-61(c). Dimensions of the 150w Lamp with DC Bayonet Base.



Function. The FA-251-AC is a 120 volt AC version of the 190 mm 12 volt DC optic. The FA-251 AC must be mounted on rigid structures and will provide a maximum nominal range for a white or colored light of 17 or 15 nautical miles, respectively.

Features

- .Requires precise leveling
- .Replacable clear, red or green lenses and lens cover
- .Forced air cooling
- .Selection of RPM and number of flash panels (up to six)
- .Cannot be used with color sectors in the lens cover
- .AC replacement for the DCB-10 beacon
- .Daylight control supplied by manufacturer.

Related Equipment. The FA-251-AC must be equipped with the CG-4P lampchanger and 120v, 150w tungsten-halogen lamps (Q150DC/CL). The 120v, 250w lamp cannot be used in the optic because the lamp is physically too large.

Additional Data. Procurement of the FA-251-AC is by term contract from the manufacturer, Automatic Power, Inc. (API).

.The FA-251-AC differs from the Amerace Corporation 190 mm and most parts are not interchangeable.

The FA-251-AC uses an AC daylight control supplied by API. The rotation of the optic is daylight controlled. The flash characteristics of the optic depend on the beam pattern and rotation speed selected. Questions should be directed to Commandant (G-EOE-4).

Table 6-25
Characteristics of the FA-251-AC
Using a 120w, 150w Lamp

Rotation Rate (RPM)						
	1	2	4	5	10	
Nominal Range						
Clear Cover (nmi)	17	17	15	15	14	
Nominal Range						
Colored Cover (nmi)	15	14	13	12	11	
Vertical Divergence	Horizontal Divergence					
Degrees	Degrees					
50% of Peak Intensity	8.2	50% of Peak Intensity				1.0
10% of Peak Intensity	10.6	10% of Peak Intensity				2.0



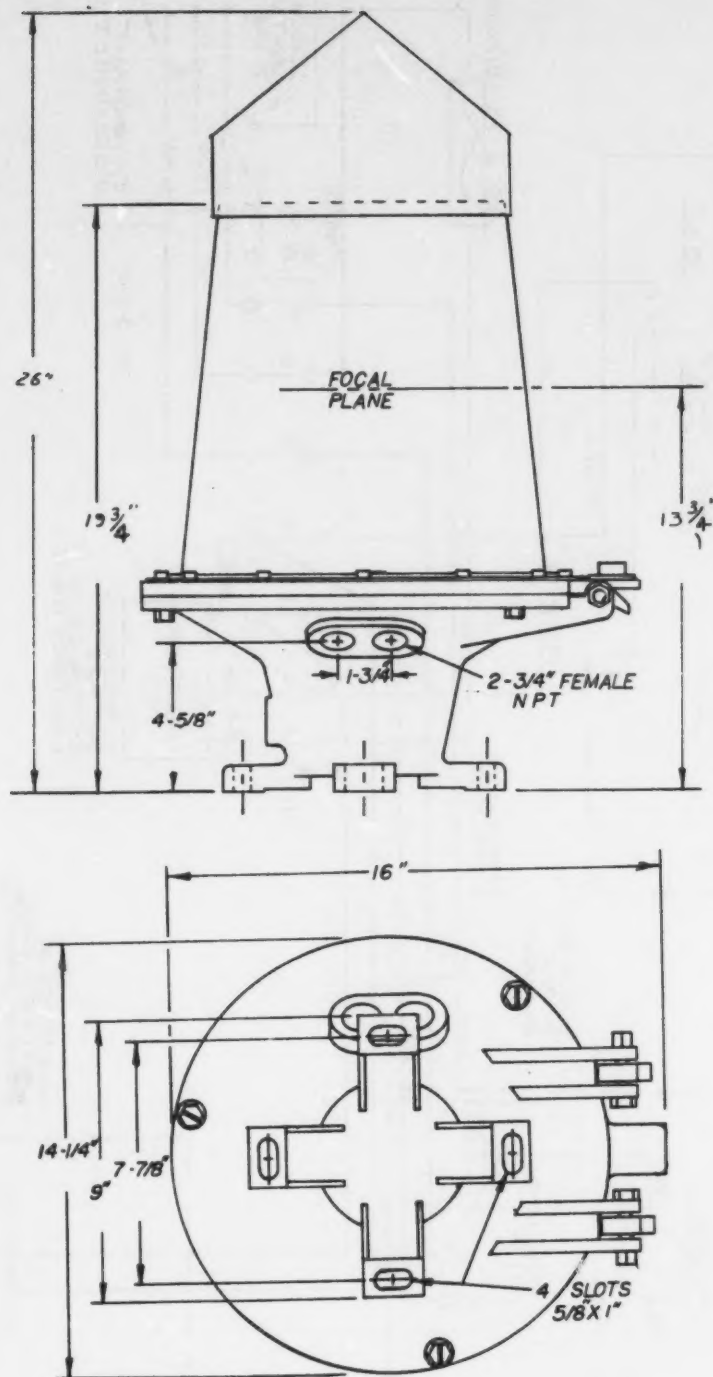
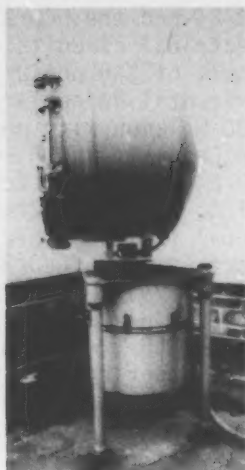
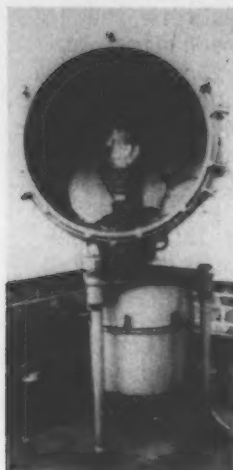


Figure 6-64 Sketch of FA-251-AC showing overall dimensions

DCB-24 AND DCB-224



Features

- Aluminum base and housing
- One drum or two drums with variable beam separation in the horizontal plane
- Operates at the rated characteristic in a 100-kn wind
- Rotation detection by a magnetic reed switch
- 120 Vac, two-place lampchanger with arc suppression and mode detection
- Separate lamp and motor circuits
- 1800 rpm, class C, 1/4 hp motor which draws 4.9 A at 120 Vac
- No clutch on the speed reducer
- Requires precision focusing and leveling
- Replaceable clear, green, or red drum covers
- Available without motor drive and gearing assembly for use as a sighted pencil beam light.

Function. The DCB-24 and DCB-224 are the Coast Guard's standard landfall lights. These optics are used for lights that must have a nominal range greater than 18 nmi. The DCB-24 and DCB-224 emit one and two pencil beams, respectively, which sweep the horizon.

Table 6-24
Equivalent Fixed Intensities and Nominal Ranges of the DCB-24 and the DCB-224

Speed (rpm)	Apparent Flash Length (sec)	Effective Intensity w/ Clear Cover (cd)*	Nominal Range (nmi)			
			At Peak Intensity		15% Peak Intensity	
			White	Colored	White	Colored
1	.63	1,180,000	26	21	21	17
2	.32	860,000	25	21	20	16
3	.21	690,000	24	20	19	15
4	.16	580,000	24	20	19	15
5	.13	510,000	23	19	19	15
6	.11	450,000	23	19	18	14
10	.06	310,000	22	19	17	14
12	.05	270,000	22	18	17	13

*The transmittance of the red and green covers relative to the clear cover is 0.20.

Data Sheet 6-D(15). DCB-24 and DCB-224 rotating optics.

Photometric, Electrical, and Mechanical Characteristics

The following list gives the characteristics of the white and colored pencil beams emitted from a DCB-24 or DCB-224 drum equipped with the 120 Vac, tungsten-halogen lamp:

Lamp current rating (A)	8.3
Power (W)	1000
Vertical divergence (degrees)	
50% of peak intensity	±2.3
15% of peak intensity	±2.9
Horizontal divergence (degrees)	
50% of peak intensity	±0.7
15% of peak intensity	±1.1

The manufacturers' manuals for the DCB-24 and the DCB-224 describe the electrical circuits and mechanical assembly of the optics and the two-place, horizontal-swing lampchanger for 120 Vac, 1000 W lamps with mogul bipost bases. The Carlisle and Finch manual for the DCB-24 is labeled Contract No. DOT-CG-3218A, Book No. M24-B263 (1974) and the manual for the DCB-224 is labeled Contract No. DOT-CG-3218A, Book No. M24-B262 (1974). The Crouse-Hinds manual, Bulletin A-229-5/65, describes the DCB-24 and DCB-224. The parts of the Carlisle and Finch and Crouse-Hinds optics and lampchangers are *not* interchangeable.

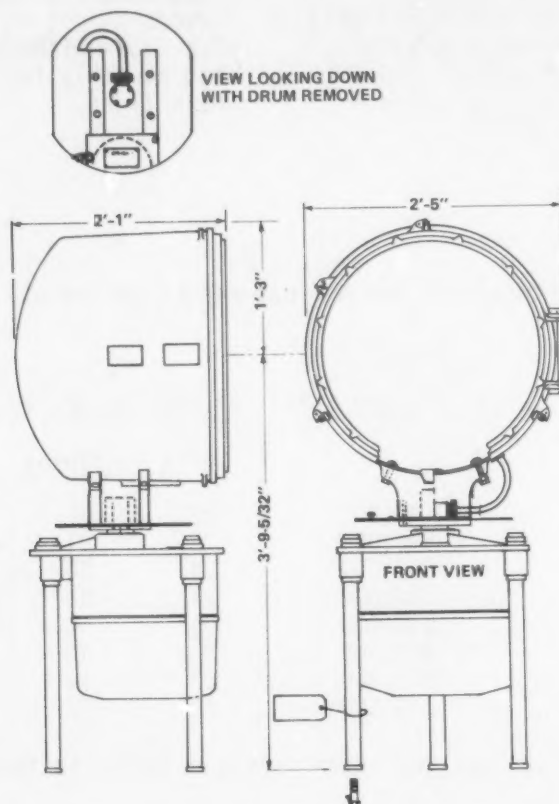


Figure 6-65. Dimensions of the Carlisle and Finch DCB-24.

Data Sheet 6-D(15). (cont'd).

Related Equipment. The DCB-24 and DCB-224 shall rotate 24 hr/day when daylight controlled unless precautions are taken to protect the lampchanger from solar heat. An ac flash controller equipped with a fixed flasher and a type L daylight control shall be used if these optics are daylight controlled. An audio-visual controller can be used to monitor these optics and to interface the main light with an emergency light. The controllers are described in Chapter 8.

The 120 Vac, two-place, 1000 W, horizontal-swing lampchanger (CG-2P1000) that is used in the DCB-24 and DCB-224 is also used in classical optics. These optics can be daylight controlled and monitored as described above. A 120 Vac, 1000 W, tungsten-halogen lamp with a CC-8 filament and a mogul bipost base is used in the CG-2P1000 lampchanger.

Additional Data. Technical specifications for the DCB-24 and DCB-224 are

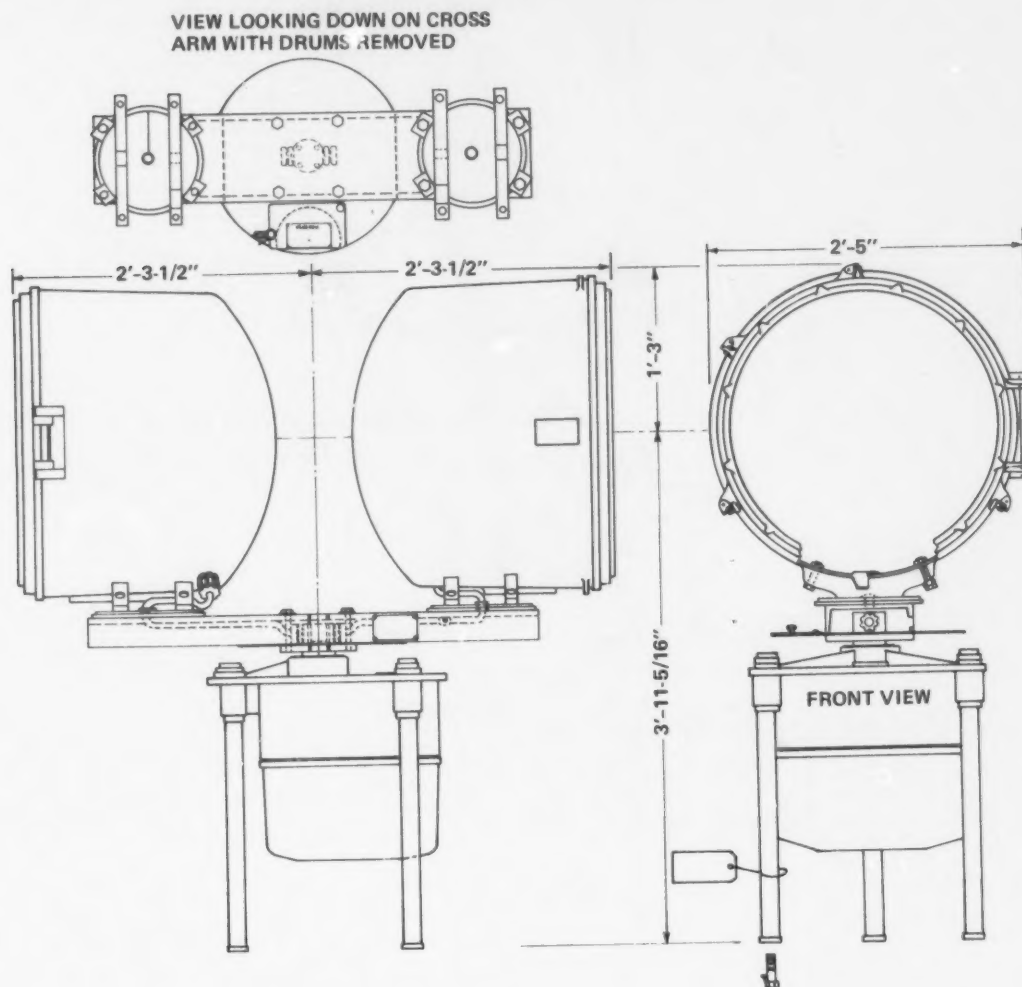


Figure 6-66. Dimensions of the Carlisle and Finch DCB-224.
Data Sheet 6-D(15). (cont'd).

Additional Data (cont'd)

contained in G-EOE Purchase Description No. 226, dated October 1972. The manufacturers are Carlisle and Finch Co., and Crouse-Hinds Co. The DCB-24 and DCB-224 are APA material, with a 2-yr leadtime on orders. ~~Spare parts are available~~

~~from the manufacturers.~~ The CG-2P1000 lampchangers are APA material available through LAMP or from Carlisle and Finch. The nonrotating DCB-24 can be ordered directly from the manufacturers.

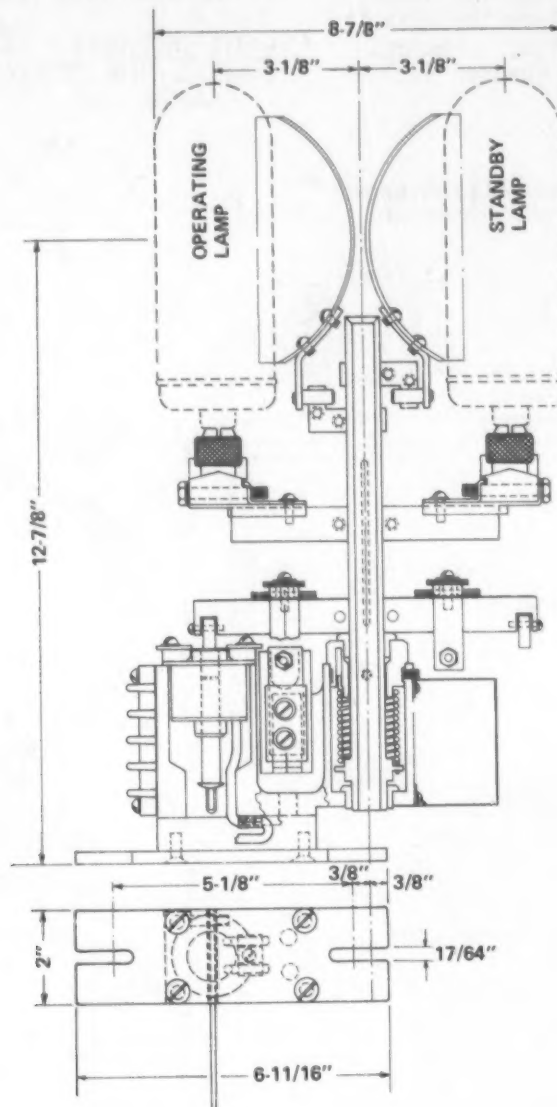


Figure 6-67. Dimensions of the Carlisle and Finch CG-2P1000 lampchanger.

Data Sheet 6-D(15). (cont'd).

Additional Data (cont'd.)

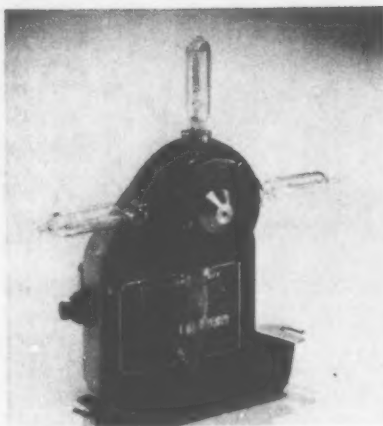
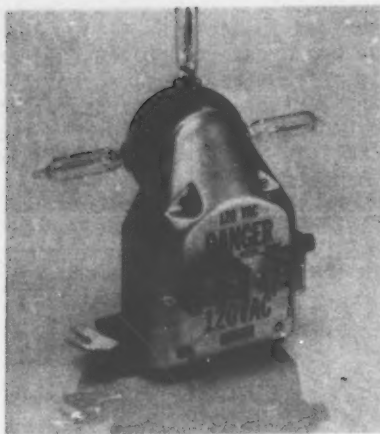
Replacement parts for the Carlisle and Finch 24-inch rotating beacons and 24-inch range lights will be available and procured from the E/G-ICP supply fund. This procedure will be implemented Aug. 1983. A list of spare parts that will be available from the E/G-ICP

are provided in Table 6-24(a). Beacons will be procured by COMDT (G-EOE) and Districts from the manufacturer, Carlisle and Finch. Replacement parts not stocked in the E/G-ICP may be procured directly from Carlisle and Finch as stated in their manuals.

Table 6-24(a)
BROOKLYN SUPCEN
Spare Parts List

Part Description	Carlisle & Finch Part Number	Stock Number
Speed Reducer #1MSFD	8887-1	CG-3010-01-GL2-9948
Speed Reducer #2MSFD	8887-2	" 9949
Speed Reducer #3MSFD	8887-3	" 9950
Speed Reducer #4MSFD	8887-4	" 9995
Speed Reducer #5MSFD	8887-5	" 9951
Speed Reducer #6MSFD	8887-6	" 9952
Speed Reducer #7.5MSFD	8887	" 9953
Speed Reducer #10MSFD	8887-10	" 9954
Speed Reducer #12MSFD	8887-12	" 9955
Synch. Motor, 1/4 HP	8883	CG-6105-01-GL2-9994
Set of 4 Brushes	3034	CG-5977-01-GL2-9997
Slipring Assembly (Double Drum)	8469XB	CG-6105-01-GL2-9996
Slipring Assembly	8469XA	CG-6105-01-GL2-9956
Cover Glass, Clear	SL547	CG-6210-01-GL2-9957
24-in. Parabolic Mirror	347M	" 9958
Lampchanger, CG2P-1000 With Monitor Kit	LC8949	CG-6250-01-GL2-9992
Arc Suppression Kit	9284X	CG-6250-01-GL2-9993
Secondary Reflector Assembly	6952X	CG-6210-01-GL2-9959
Lampchanger Solenoid Coil	6827X	CG-5950-01-GL2-9960
Lampchanger Spring Drive	6843	CG-5950-01-GL2-9961
Lampchanger Relay	8908	CG-5945-01-GL2-9831

FOUR-PLACE 120 Vac LAMPCHANGER



Function. The CGAP-120 lampchanger supports four 120 Vac, 250-W lamps with the filament of the operating lamp at the focal point of the lantern. Lamp out sensing circuit automatically rotates the turret (CCW) to the next serviceable lamp; it turns off power without researching for good lamps when the lamp in the fourth position fails.

Features

.Fixed contact assembly; no moving electrical contacts or brushes other than lamps.

- .Automatic contact cleaning before each lamp is activated
- .Lamps easily installed or removed even when wearing heavy winter gloves. Push in to install, tilt and pull out to remove.
- .Symbolic X is formed by four burned out lamps, serves as a visual alarm
- .A test button simulates lamp failure and activates automatic rotation.
- .Fail-safe lamp out sensing not affected by power outages or daylight controlling.
- .Conical profile eliminates lampchanger shadowing to the lowest fresnel lens element (excluding the spare lamp envelope), full 360° light intensity is achieved
- .Heat sinking built into turret maintains cool lamp base temperature, safely radiates excess heat energy.
- .Turret thermally isolated from electronic enclosure by Teflon bushing.
- .The lampchanger has two modes of operation: In the monitored mode the lamp and motor terminals are electrically isolated by at least 10⁶ohms and independent voltages applied at the lamp and motor terminals with a common neutral terminal. In the unmonitored mode the lamp and motor terminals are electrically connected by a shorting strap and the lamp out sensing and turret activation are accomplished with the same voltage that is applied to the lamp circuit at the lamp and neutral terminals.

Electrical and Mechanical Characteristics

Input voltage range	100-130 Vac
Frequency range	57-63 Hz
Operating impedance	5000 ohm max
End of search	10 megohm min impedance
Control circuit power	5 W max continuous
Safety	Frame, Turret & Cover Electrically Grounded
Weight	24 oz.
Mounting Pattern	3.00 x .625 + .005
Mounting Screws	10-32 x .50 binding head (4 required)

Electrical and Mechanical Characteristics (cont'd)

Lamp Focal Position	6.500 + .062 above and central to mounting pattern
Ambient temperature	-30° to +170°F
Relative Humidity	100% MIL STD 810B #507
Salt spray	Continuous, MIL STD 810B #509
Vibration	5-500 CPS MIL STD 810B #514
Shock	30G, MIL STD 810B #516

Related Equipment

The lampchanger fits the following Coast Guard optics:

1. With bracket provided, P.N. 243.1016, the lampchanger unit fits into the 300mm lantern (Tideland Signal Corporation) P.N. 630.1091.

2. By substituting the lampchanger bracket kit, P.N. 2101-146, the lampchanger unit fits into the vented 250mm lantern (Amerace Corporation) P.N. 2101-B1C.

3. WITH BRACKET PROVIDED, THE LAMPCHANGER UNIT FITS INTO THE FA-251-AC. The lampchanger is powered by the AC flash controller or the audio-visual controller, described in Chapter 8.

Additional Data. Technical specifications for the CG4P-120 are given in the G-EOE Specification 266C, May 1978. The Tideland Signal Corporation manufactures the lampchanger. It is free issued by E/GICP from Commodity M, APA stock. The NSN is XB 6250-01-019-6282. The lampchanger warranty period is one year from the date shipped out of E/GICP. Send lampchangers that fail in warranty to Tideland Signal Corporation. Send lampchangers that fail out of warranty to COMDT (G-EOE).

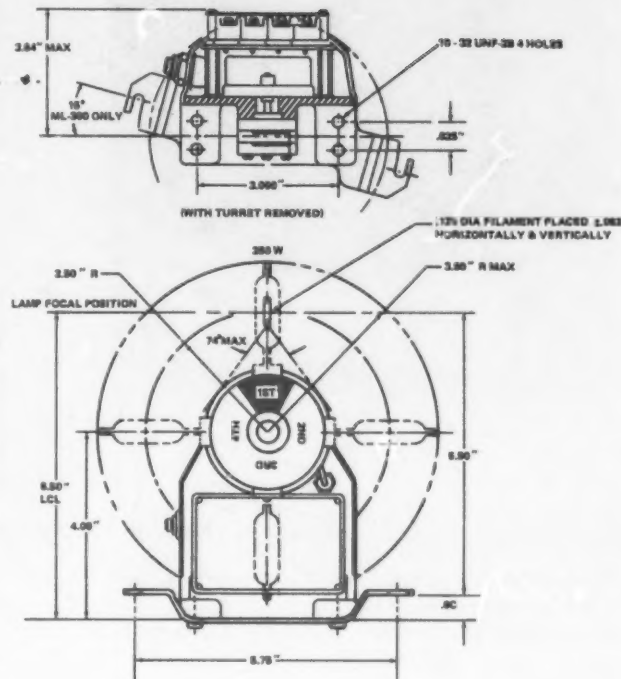


Figure 6-68. Dimensions of the CG4P-120 and Lamp Placement Tolerances.

Towers

Preparation. Steel skeleton towers shall be prepared in accordance with section 4.2.3.3 of the *Coatings and Color Manual* (CG-263).

Installation. All towers shall be installed in accordance with applicable district (ecv) drawings and specifications.

Platforms. All platforms shall be designed so that they can support all the equipment and servicing personnel that might be on the aid at one time with a safety factor of four. (Assume servicing personnel to be a minimum of 200 lb.) Installation of platform railings should always be given serious consideration because of the importance of providing the safest practical conditions for climbing and servicing beacon structures. Each district shall determine the necessity and feasibility of installing platform railings. If it is determined that a beacon structure should be so equipped, the railings shall conform to Title 29 of the *Code of Federal Regulations* (Chapter XVII, Part 1910, "Occupational Safety and Health Standards," Section 23), as directed by the *Safety Manual* (CG-405). If a beacon structure is not equipped with platform railings, some means shall be provided for servicing personnel to be free to work without having to hold on.

Preparation

•Wood. Wood decking for the platform shall be preserved as outlined in section 4.2.2 of CG-263.

•Metal. Metal grating shall be coated as described in section 4.2.3.3 of CG-263.

•Concrete. No preparation is required for a concrete slab platform, as stated in section 4.2.5 of CG-263.

•Other Materials. Fiberglass, plastic, or aluminum grating can be effectively used as maintenance-free platforms.

Installation. All platforms shall be installed as shown on the applicable drawing.

Related Equipment

Ladders

•Preparation

1. Wood. As outlined on Data Sheet 4-D(16), wood ladders are used only when dictated by special circumstances. All wood ladders shall be fabricated from lumber that has been properly preserved, in accordance with section 4.2.2 of CG-263.

2. Metal. Metal ladders shall be coated as described in section 4.2.3.3 of CG-263.

•Installation. All ladders shall be designed and installed in accordance with the above-referenced *Code of Federal Regulations* (Sections 1910.25, 1910.26, and 1910.27), as directed by CG-405.

Safety Climbing Devices. Preparation and installation of all safety climbing devices shall be per manufacturers' instructions and in conformance with Chapter 2 of the *Tower Manual* (CG-358).

Battery Boxes

•Preparation. The battery box is predrilled for the plastic stuffing tube that shall be installed to keep it watertight.

•Installation. The battery box shall be installed on the platform of the beacon structure, in proximity to the lantern. Refer to Chapter 6 of this volume for the maximum length of power cable allowed between the lantern and the battery box. Where possible, the battery box shall be located so that it is effectively hidden by the daymark, as shown in Figure 4-4.

Lag screws or machine nuts and bolts are used to secure the battery box to the platform. When mounting the box, al-

Related Equipment (cont'd)

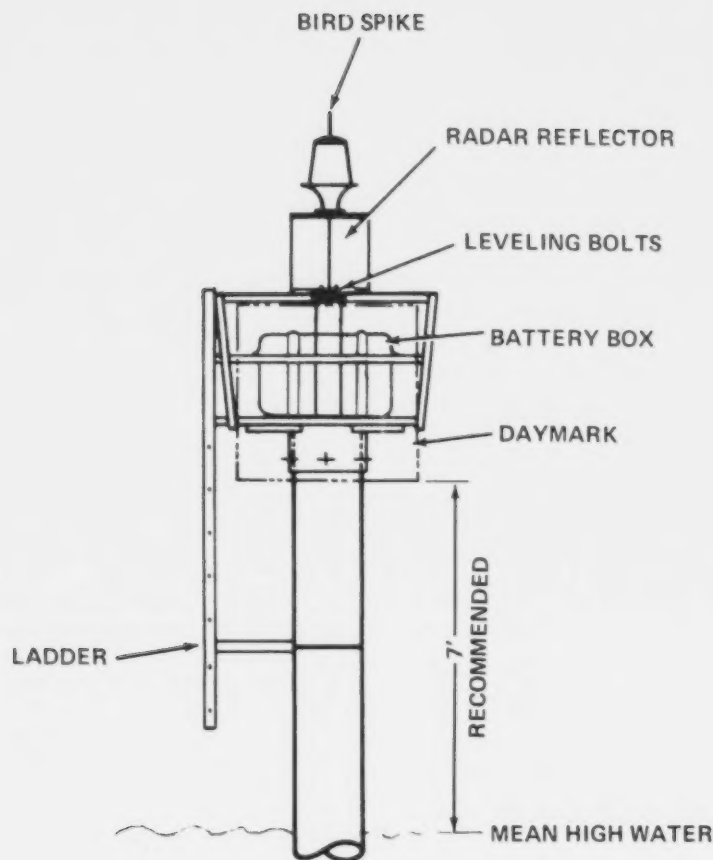


Figure 4-4. Location of battery box, radar reflector, and dayboard on a lighted beacon structure.

lowance should be made for drainage of water under it.

The battery box has a snap lid that is normally sufficient to secure the top. At the time of manufacture, however, four pilot holes are drilled through the lip of the battery box top--if necessary, four corresponding holes can be drilled through the lip of the bottom to further secure the top with nylon line:

Plastic battery boxes shall not be used as lantern supports.

Cables shall not be installed in the screen-covered air vent holes, which are essential for the operation of the batteries and must be protected from the entrance of vermin.

The first failure of cable is often due to corrosion of the terminals. Therefore, when installing new lead-in wires, allow about 1 ft of extra wire inside the battery box. If the lugs or the wire at the terminal require replacement, the cable can then be trimmed a few inches and new lugs installed.

Related Equipment (cont'd)

Dayboards

•Preparation. The preparation of dayboards shall be as outlined in Chapter 5.

•Installation. A dayboard shall always be installed on a beacon structure in a position that gives it maximum usefulness. Where feasible, the daymark shall be the dominant component of the silhouette, with the battery box hidden behind it as shown in Figure 4-4.

As described in Section A of this chapter under "Operational Requirements," all 1-, 2-, and 3-mi dayboards shall be mounted so that the bottom of the dayboard is at 7 ft above mean high water, as shown in Figures 4-4 and 4-5. At the discretion of District Commanders, the dayboards on a specific beacon structure may be raised if other objects are likely to obscure it or expected wave height exceeds the 7-ft level at that location.

Daymarks shall normally be installed vertically. When heavy bird fouling on the face of the daymark is anticipated, it may be installed approximately 5 degrees out of the vertical plane--leaning toward the observer, as shown in Figure 4-5.

Whenever possible, daymarks shall be mounted on an angle to the channel line, as shown in Figure 4-5. This angle will vary to best suit the particular channel, but for a straight channel line it should be about 30 degrees. This will make the numbers easier to read when the aids are nearly abeam. However, in some circumstances this is not practical, such as with "H" piles or square platforms, in which case the daymark should be mounted perpendicular to the channel line, as shown in Figure 4-5.

The method of mounting dayboards is optional and will be left to the discretion of District Commanders. Nails, U-bolts, J-bolts, corner clamps, and

edge clamps are commonly used for attachment. Fasteners shall not pierce the reflective borders or characters, but should penetrate the colored fluorescent films. The fastenings should be designed so that the daymark becomes sacrificial in extremely high winds. Two or three daymarks can be replaced at a relatively small cost compared to an entire beacon structure.

Lanterns. Preparation and installation of lanterns shall be as outlined in Chapter 6. Lanterns shall be mounted directly above the dayboards, except where specific operational requirements dictate otherwise.

Sound Signals. Preparation and installation of sound signals shall be as outlined in Chapter 7.

Radar Reflectors

•Preparation. Radar reflectors for use on lighted and unlighted beacon structures should generally be of a dihedral corner arrangement, with circular end plates. In some cases, the required radar range necessitates the use of a specially designed radar reflector.

•Installation. Radar reflectors shall be installed on beacon structures only when it is deemed operationally necessary. On an unlighted beacon structure, the radar reflector shall be mounted on the top--just above the daymark. On a lighted beacon structure, the lantern shall be mounted flush on top of the radar reflector. The lantern leveling bolts should be placed between the lantern stand and the radar reflector (as shown in Figure 4-4) to allow for simultaneous leveling of the two components. The combination of the radar reflector and lantern shall be leveled in accordance with the standards contained in Chapter 6.

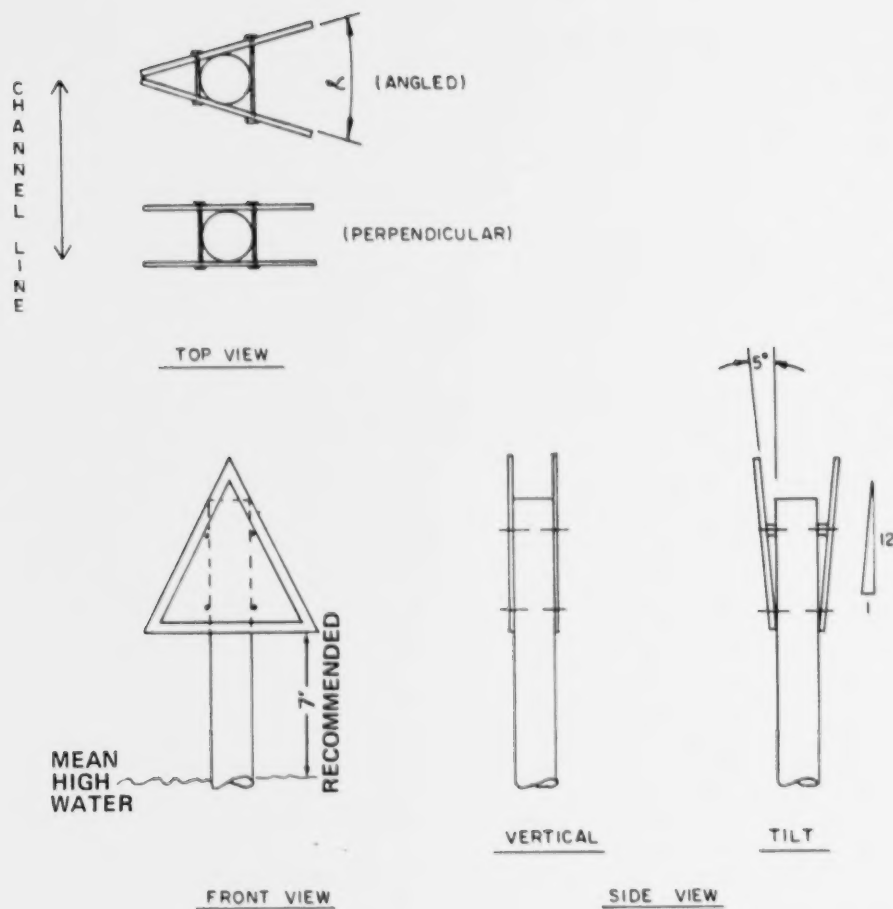


Figure 4-5. Daymark mounting details.

C. INSPECTION, MAINTENANCE, AND REPAIR ON STATION

Inspection and Maintenance Schedule

Lighted Structures. Inspection and maintenance of lighted beacon structures shall be scheduled once a year, when visiting the aid to service the installed signals.

Unlighted Structures. Inspection and maintenance of unlighted beacon structures shall be scheduled once a year, when visiting the aid to service the daymarks.

Inspection and Maintenance Requirements

Maintenance Policy

•General. Preventive maintenance of beacon structures is usually not performed on station.

•Exceptions. On certain beacon structures, the surface area is such that it makes a useful contribution to the distance at which the aid can be seen. There are other cases when long-established practice makes the surface color a significant factor in recognition of the aid by local mariners. Under such circumstances, red, black, or white, as appropriate, are acceptable and authorized surface colors for beacon structures. Gray is no longer an authorized color.

At the discretion of the District Commander (ecv), those individual beacon structures that require maintenance may be designated by a note in the comment document section of SANDS form 4429A, as follows: "Preventative maintenance of structure is required." This decision shall be based on a life-cycle economic analysis of maintenance costs versus replacement costs. Any structure not so designated shall be inspected as required herein.

Components. The following paragraphs list the minimum inspection and maintenance requirements for the basic components found on structures. Com-

ponents not listed here, but found on specific structures, shall be inspected to ensure that they are capable of continuing to perform their intended function safely. Throughout this section, the words "replaced (or repaired) when necessary" shall refer to when the component appears to be incapable of performing its designed function until the next scheduled service visit or when its condition constitutes a safety hazard.

•Piles. All piling shall be inspected for structural integrity, soundness, and stability. Vertical single piles shall be checked for leaning and straightened if necessary. If a servicing unit considers a pile to be deteriorated to the extent of being unsafe to support servicing personnel or unable to survive expected weather conditions, the District Commander (ecv) shall be notified so that a detailed inspection can be performed. Piles shall be replaced or repaired (e.g., concrete encasement) as necessary.

1. Timber Piles. Pest infestation shall be checked down to the low water level. Timber piles shall be carefully inspected for the presence of marine borers since deterioration and rotting due to other causes are accelerated by borer damage. Attacks often result in the commonly observed narrow-waisted or hourglass effect of the pile, but sometimes the only signs of borers are small holes below the waterline and a general weakening of the pile. Piles shall be sounded (tapped) with a hammer to determine whether the interior has deteriorated. A dull sound with little rebound of the hammer indicates a soft interior. Generally, the surface of the pile should not be pierced, but, if necessary, the pile may be poked with a knife or other sharp instrument to see if the wood is sound. For more information, see the Civil Engineering Technical Report, *Marine Borers*, CG-600-2.

Inspection and Maintenance Requirements (cont'd)

2. Steel Piles. Careful attention shall be given to the tidal zone (or splash zone) in which the most severe corrosion is likely to occur. Corrosion on "H" piles is likely to proceed more rapidly on flange edges. Determination of when a steel structure has corroded to the point of significant reduction of its strength is difficult, even with complex instrumentation. Field inspections shall consider the extent of the visible corrosion and how much it has progressed since the last inspection. It is generally better to leave corrosion products (rust or scale) in place to retard further corrosion of the remaining steel. If the deterioration seems extensive, tapping with a hammer or poking with a sharp instrument (spike, etc.) will aid in the confirmation of that degree of deterioration which warrants replacement of the pile.

3. Concrete Piles. Concrete piles shall be carefully inspected for spalling (chipping or flaking) of the concrete and signs of deterioration of the prestressed reinforcement. The latter can usually be detected by signs of rust running out of cracks in the concrete and by spalling in a line over the reinforcement steel.

•Platform. The platform decking or grating shall be inspected for structural integrity and soundness and repaired or replaced when necessary. Platform protective railings shall be inspected for deterioration and replaced when broken, severely bent, or otherwise considered unsafe.

•Tower. All structural components of the tower shall be checked for structural stability and repaired or replaced when necessary.

•Ladder. Wooden ladders shall be inspected for decay, dry rot, pest infestation, missing rungs, or improper mounting and shall be replaced when necessary.

•Safety Climbing Device. The safety climbing device shall be inspected to

ensure that it is in proper working condition and replaced when necessary. The District Commander (ecv) shall be notified of any structures higher than 20 ft that are not equipped with a safety climbing device.

•Dayboard. All dayboards shall be inspected as outlined in Chapter 5.

•Battery Box. Battery boxes shall be inspected to ensure that they are intact and securely fastened to the platform, that lids are firmly snapped on, and that stuffing tubes and insect screens are in place. Boxes shall be replaced as necessary, ensuring, where practical, that they are hidden behind the daymark.

•Wiring. All wiring shall be visually checked for cracking and deterioration. Any wire not in "like new" condition shall be replaced. A megohmmeter test shall be performed to check the insulation of the wire. Stuffing tubes shall be inspected and replaced if broken, damaged, or cracked. Initial cable deterioration usually occurs at the ends of the cable where the terminal lugs corrode from the salt atmosphere. If the wire appears to be in good shape except for the ends, in lieu of total replacement, it may be trimmed back to where the insulation has protected the wire and new lugs installed. If there is any doubt as to its condition, the entire wire shall be replaced.

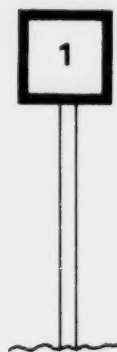
•Lighting Equipment. All lighting equipment, including lamps, flashers, lampchangers, lenses, daylight controls, condensing panels, and lanterns, shall be inspected as outlined in Chapter 6.

•Sound Equipment. The sound signals, emitters, and their separate power sources shall be inspected as outlined in Chapter 7.

•Radar Reflector. The radar reflector shall be inspected, checked to ensure that it is level, and replaced when necessary.

D. GENERAL DESCRIPTION DATA SHEETS

SINGLE PILE--WOOD



Function. A single pile wood structure is commonly used for daybeacons and lighted beacons on marine sites where exposure and bottom conditions permit. Wood piles are generally the most cost-effective type of pile structure.

Physical Characteristics

Primary structural component: wood piling (ASTM Standard D25), type II, douglas fir or southern pine

Preservative treatment: coal tar creosote or salt-treated CCA or ACC (AWPA Standard P-5 and C-3); no preservative treatment is required if knockdown is expected within 6 mo

Common lengths: 45 and 60 ft

Minimum penetration required: function of the soil type at each site location; see Selection Guide and Figure 4-1

Maximum depth of water: 20 ft

Advantages: cost, availability, ease of construction

Disadvantages: susceptible to marine borers, rotting, ice damage, beetle attack, and brooming of the tip during driving

Structural Requirements. In general, a single pile wood structure supporting the related equipment listed below can withstand the environmental loading in protected and semiexposed areas. (See design example [pages 4-6] for sample calculation.) Two requirements must be met to achieve the full structural capability of a single pile wood structure:

- the pile must achieve fixity (see Figure 4-1 and associated paragraphs)
- the physical integrity of the pile must be maintained (i.e., it must be free from brooming, splits, etc. (see Figure 4-2)).

When subject to a moderate collision, a wood pile will snap upon failure (a steel pile will yield, as stated on Data Sheet 4-D(2)).

Related Equipment. A prefabricated wood or metal platform is required to support 1-, 2-, or 3-mi dayboards, batteries, lighting equipment, and servicing personnel, as necessary.

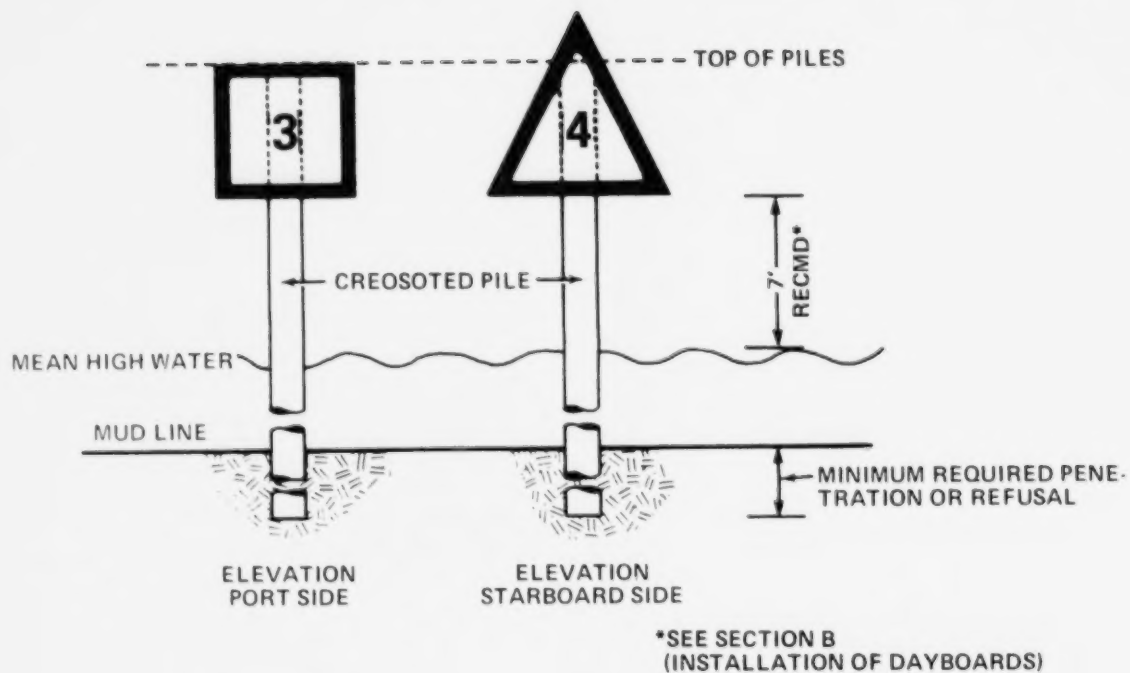


Figure 4-6. Single pile wood beacon structure (unlighted).

Data Sheet 4-D(1). (cont'd).

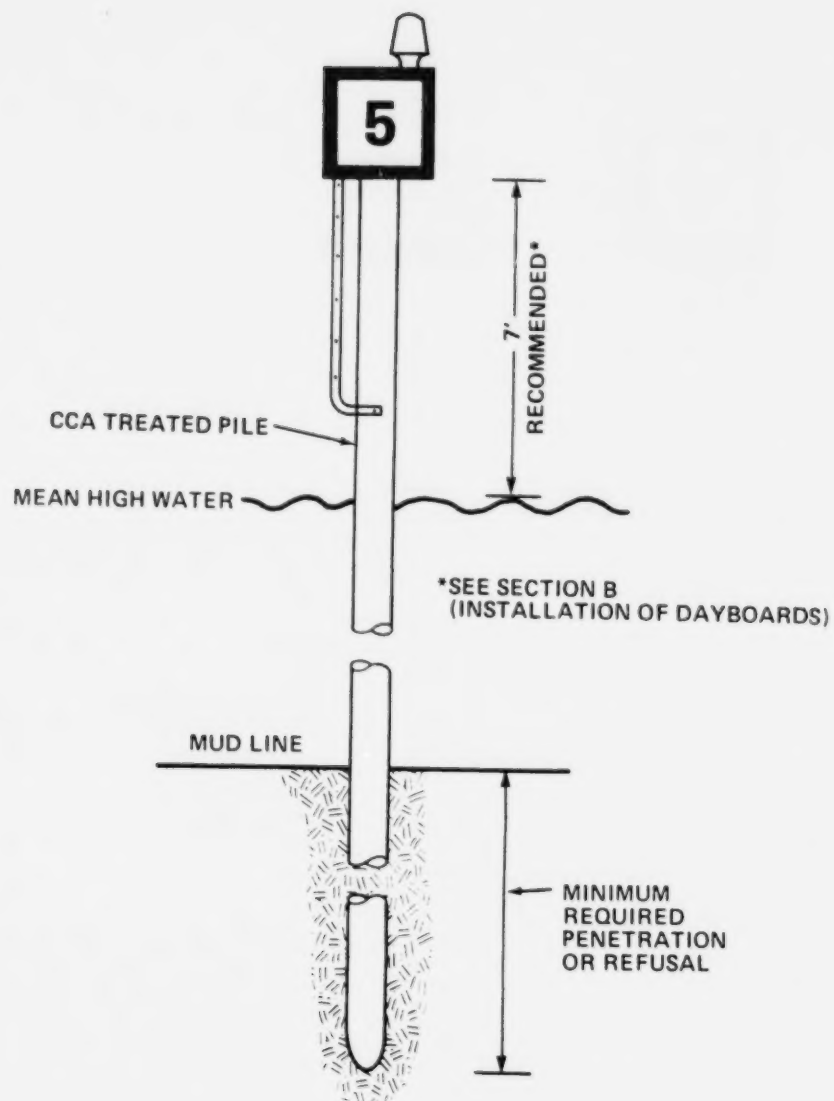
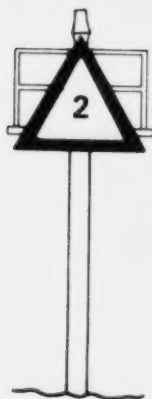


Figure 4-7. Single pile wood beacon structure (lighted).

Data Sheet 4-D(1). (cont'd).

SINGLE PILE--STEEL



Function. A single pile steel structure is used on marine sites for daybeacons and lighted beacons where bottom and exposure conditions permit or require. For moderate ice conditions or hard bottom areas, steel piles are generally the most effective type of pile.

Physical Characteristics

Primary structural component: steel piling--12- or 18-in. pipe or 12H53 "H" piling

Preservative treatment: tarset or corrosion-resistant steel

Common lengths: 30, 40, 50 and 60 ft

Minimum required penetration: function of the soil type at each site location; see Selection Guide and Figure 4-1

Maximum depth of water: 20 ft

Advantages: permanence, can withstand hard driving and moderate collision, long lengths can be attained by butt welding

Disadvantages: higher cost, limited availability

Structural Requirements. A single pile steel structure supporting the related equipment listed below can generally withstand the environmental loading in protected and semiexposed areas. (See design example [pages 4-6] for sample calculations.) The increased structural capability of a steel pile over a wood pile will *never* be realized unless the proper depth of penetration (fixity) can be achieved (Figure 4-1). When subject to moderate collisions, a steel pile will yield and can be straightened to its original position.

Several factors should be considered in selecting steel piling, as shown by the following comparisons. "H" piles can be obtained in a corrosion-resistant grade of steel, but this grade is not available for pipe piles. Pipe piles are omnidirectional in strength and exact orientation with respect to the failure modes is not critical--whereas, with an "H" pile, it is difficult to orient the axis in relation to the destructive force. In one direction, with the two flanges perpendicular to the direction of the force, the 12H53 can accept a force 41 percent greater than a 12-in. pipe pile; however, if the "H" pile is oriented with the two flanges in line with the force, it can only accept a force 45 percent less than that required to fail a 12-in. pipe pile.

Related Equipment. A prefabricated metal platform is required to support dayboards, batteries, lighting equipment, and servicing personnel, as necessary.

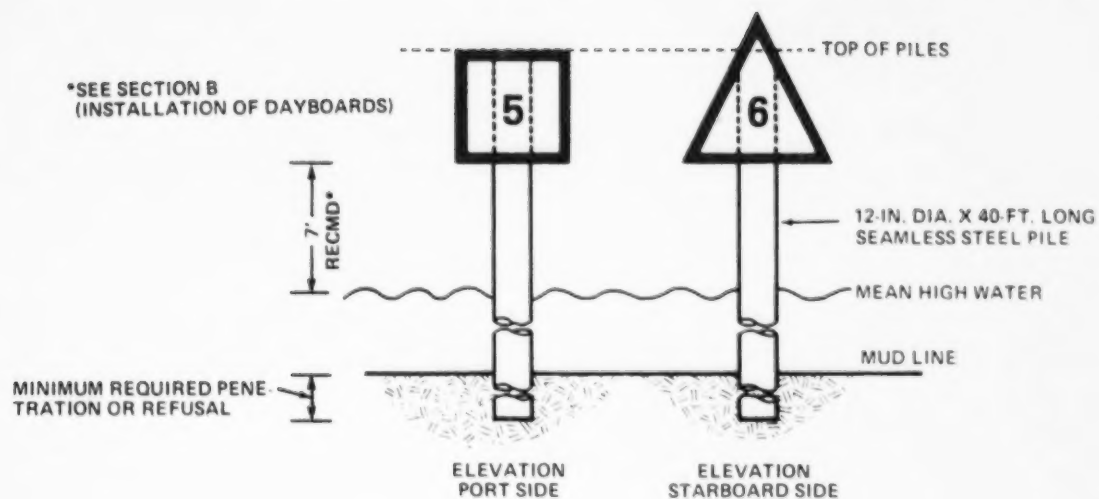


Figure 4-8. Single pile steel beacon structure (unlighted).

Data Sheet 4-D(2). (cont'd).

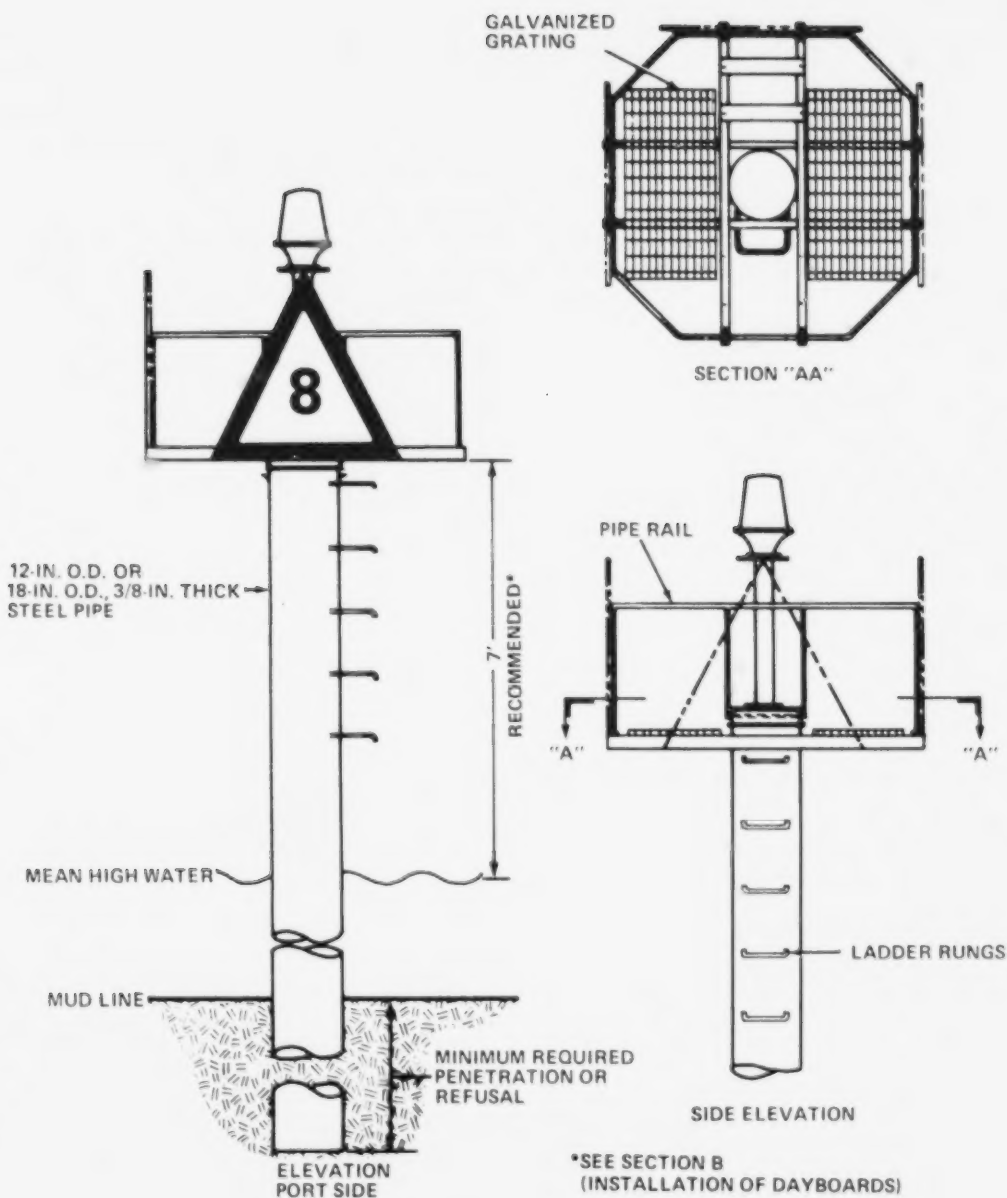


Figure 4-9. Single pile steel beacon structure (lighted).

Data Sheet 4-D(2). (cont'd).

SINGLE PILE--CONCRETE



Function. A single pile concrete structure is used on marine sites for daybeacons and lighted beacons where exposure conditions permit, but shall be used only as a last resort when wood or steel piles are not readily available.

Physical Characteristics

Primary structural component: concrete piling--10-, 12-, or 14-in. square or octagonal

Common lengths: 40, 50, and 60 ft

Minimum required penetration: function of the soil type at each site location; see Selection Guide and Figure 4-1

Maximum depth of water: 20 ft

Advantages: decay resistant, easy to manufacture

Disadvantages: tedious to handle, costly, corrosion of prestress reinforcement, spalling (chipping or flaking), requires heavy pile-driving hammer, possible cracking of pile while driving, weight

Structural Requirements. A single pile concrete structure supporting the related equipment listed below can generally withstand the environmental loading in protected and semiexposed areas. (See design example [pages 4-6] for sample calculations.) In order to achieve the full structural capability of a single pile concrete structure, two requirements must be met:

- the pile must achieve fixity (see Figure 4-1)
- the physical integrity of the pile must be maintained (i.e., it must be free from cracking, spalling, etc.).

When subject to a moderate collision, a concrete pile will snap upon failure (a steel pile will yield upon failure, as stated on Data Sheet 4-D(2)).

Related Equipment. A prefabricated metal or concrete slab platform is required to support dayboards, batteries, lighting equipment, and servicing personnel, as necessary.

Data Sheet 4-D(3). Single pile concrete structure.

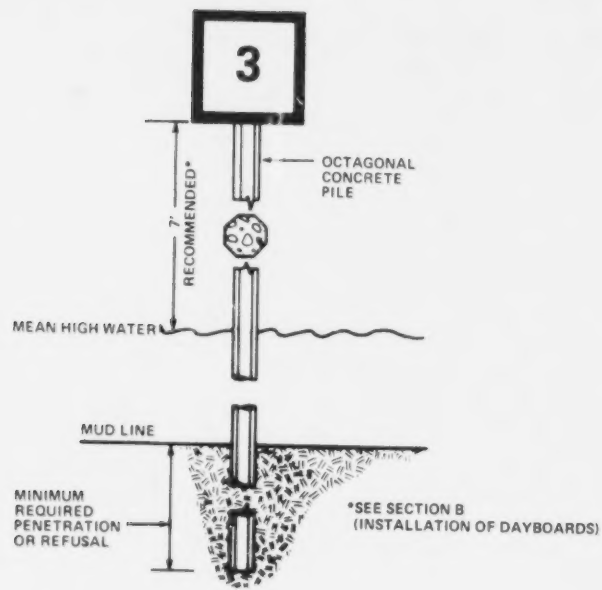


Figure 4-10. Single pile concrete beacon structure (unlighted).

Data Sheet 4-D(3). (cont'd).

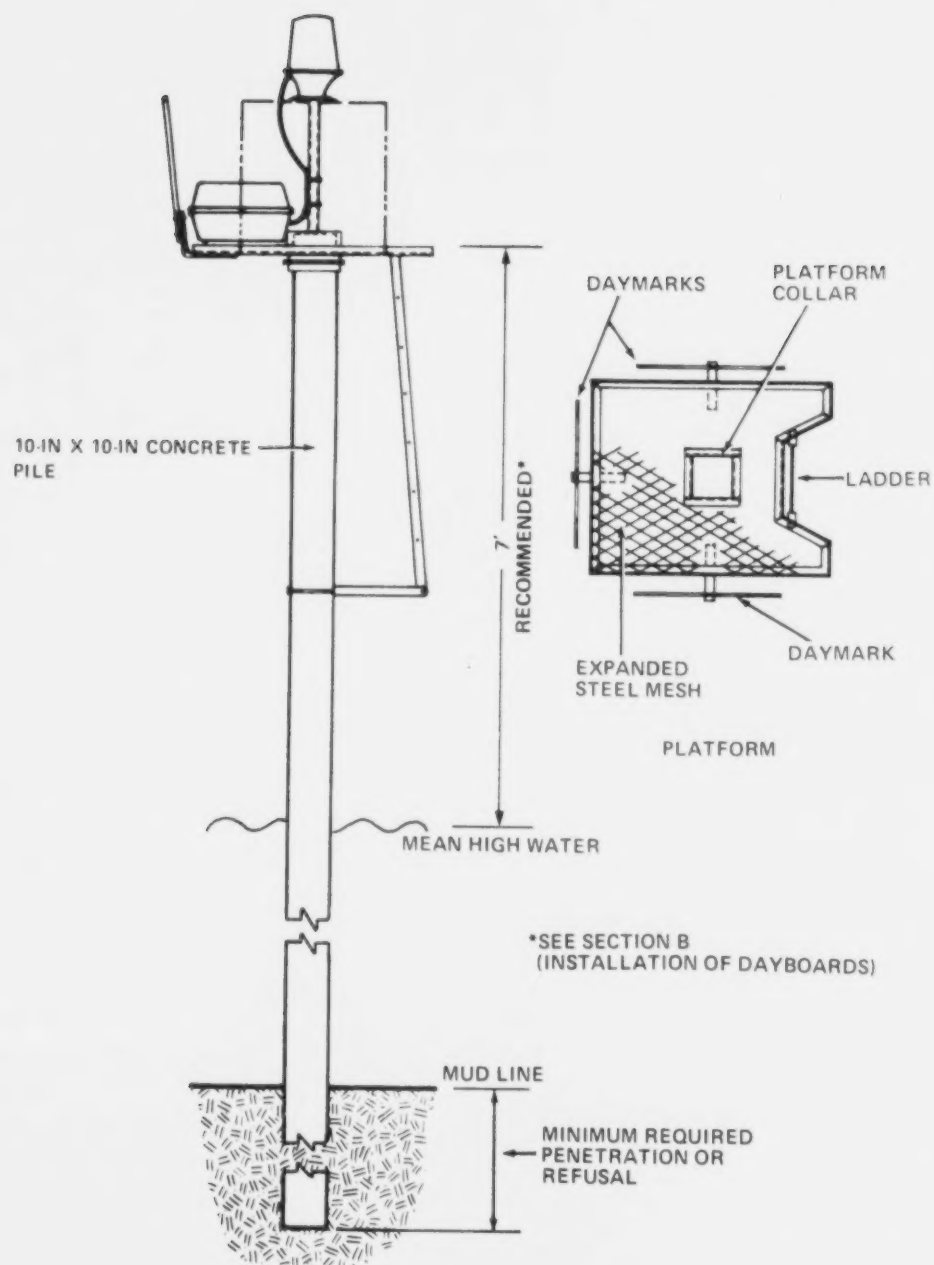
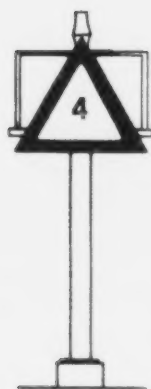


Figure 4-11. Single pile concrete beacon structure (lighted).

Data Sheet 4-D(3). (cont'd).

POST



Function. A post (steel or concrete) is a nondriven piling that is used for day-beacons and lighted beacons on land sites. It is usually secured to a concrete foundation.

Physical Characteristics

Primary structural component: steel or concrete pile

Common lengths: 20 and 30 ft

Structural Requirements. The critical element of a post structure is generally the overturning moment developed at the connection between the foundation and the post. The structure must be designed to resist this overturning moment caused by environmental forces.

Related Equipment. A prefabricated metal platform is required to support 1-, 2-, or 3-mi dayboards, batteries, lighting, sound equipment, and servicing personnel, as necessary.

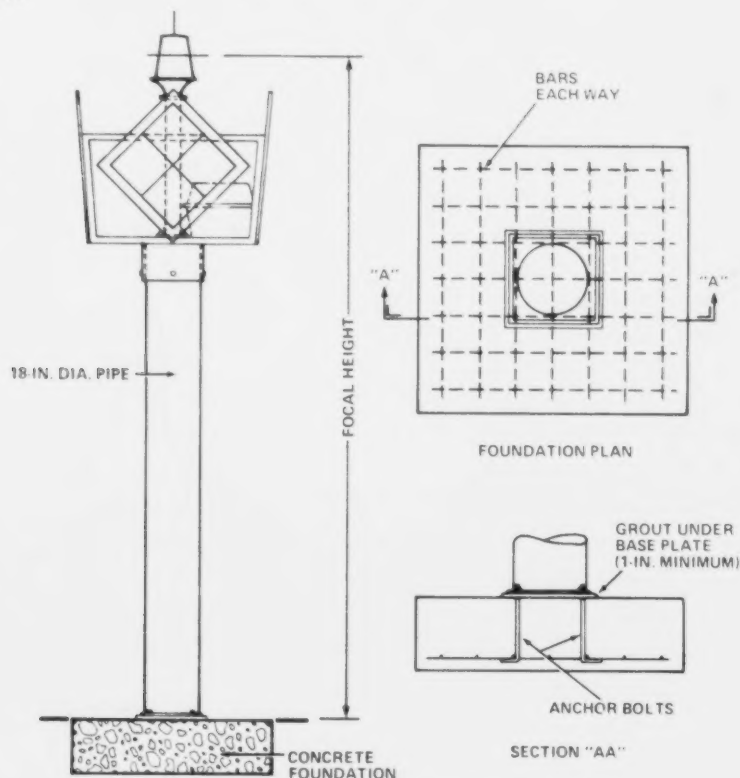


Figure 4-12. Post foundation.
Data Sheet 4-D(4). Steel or concrete post structure.

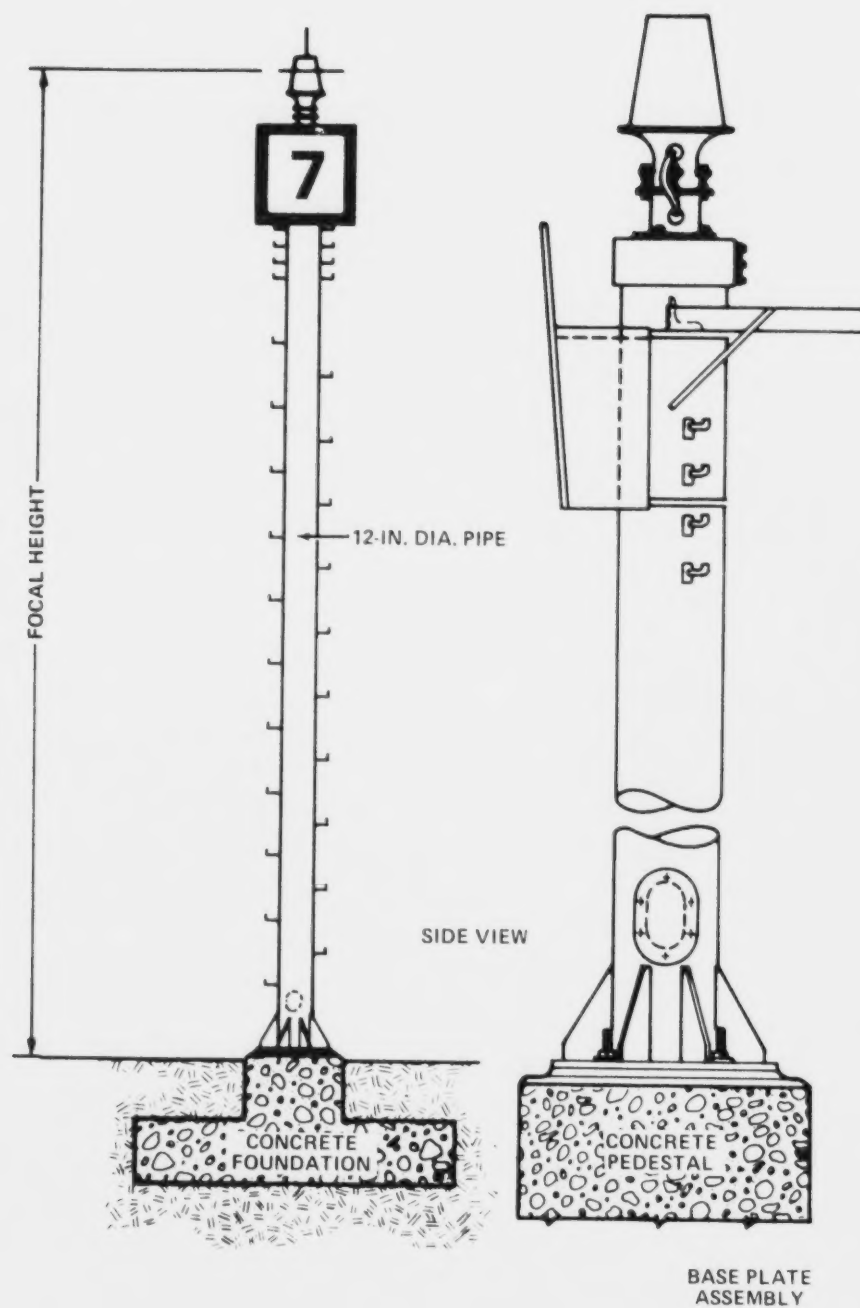
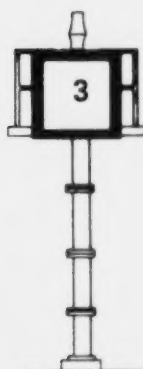


Figure 4-13. Post beacon structure (lighted).

Data Sheet 4-D(4). (cont'd).



Function. A spindle is a specialized foundation that is used for daybeacons and lighted beacons in tidal areas and on land sites. It is usually secured

SPINDLE

to a concrete foundation or to steel stakes embedded into rock with grout.

Physical Characteristics

Primary structural component: single pole made of various size sections of pipe which are connected end to end

Structural Requirements. The critical elements of a spindle are the flanges connecting the various cross sections and the base connection between the foundation and the base pipe sections. The structure must be designed to resist the overturning moment caused by environmental forces.

Related Equipment. A prefabricated metal platform is required to support 1-, 2-, or 3-mi dayboards, batteries, lighting equipment, sound equipment, and servicing personnel, as necessary.

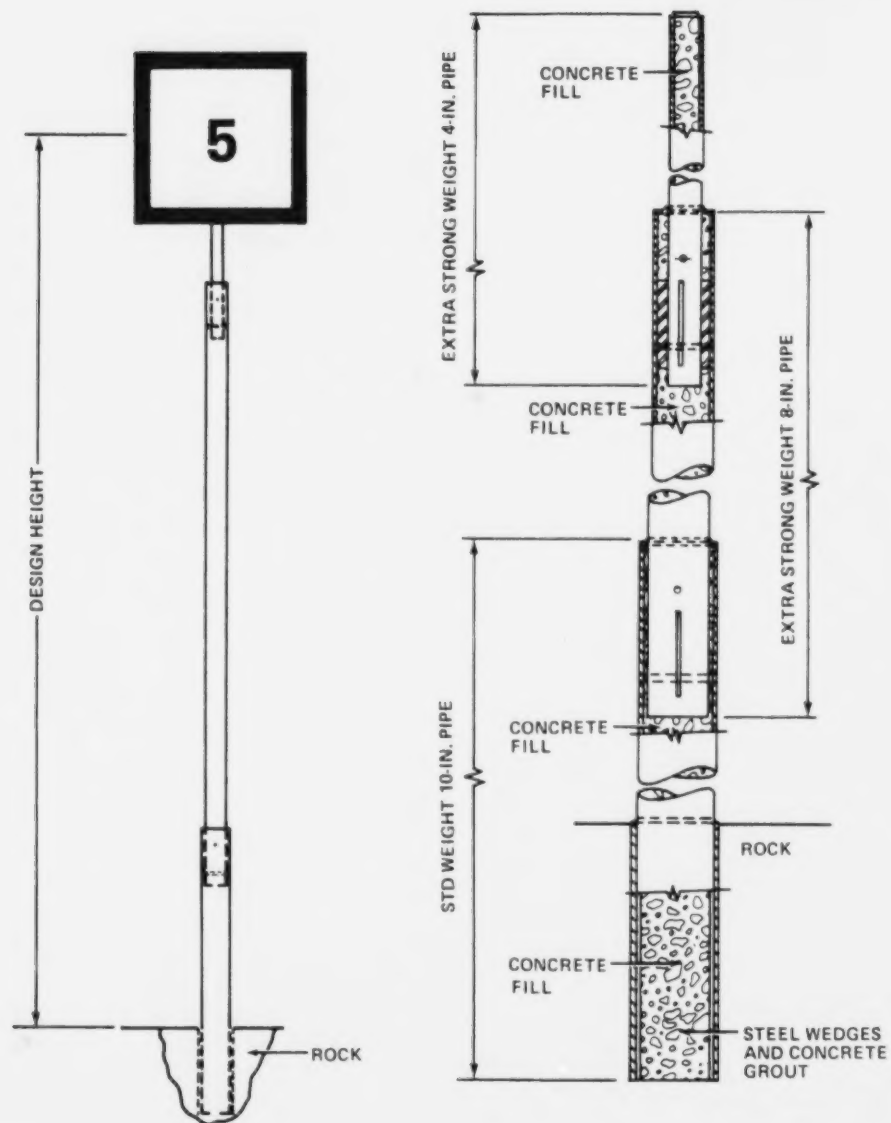


Figure 4-14. Spindle foundation.

Data Sheet 4-D(5). (cont'd).

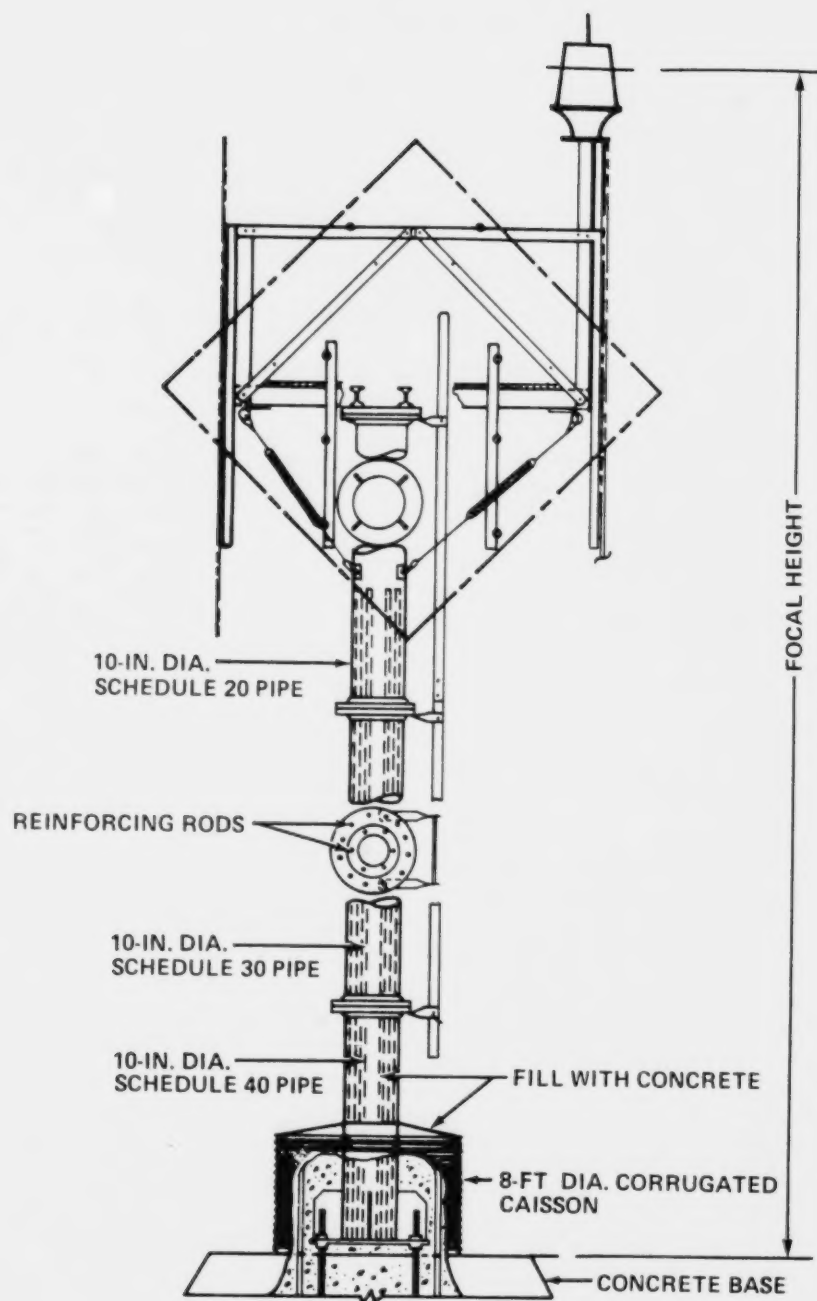
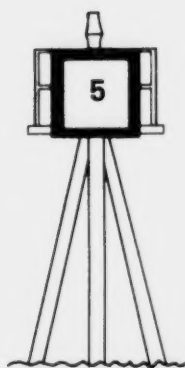


Figure 4-15. Spindle beacon structure (lighted).

Data Sheet 4-D(5). (cont'd).

MULTIPLE PILE--BATTERED DOLPHIN



Function. A multiple pile battered dolphin structure is used on marine sites for lighted or unlighted beacons when a single pile structure is not effective because of soft bottom or exposure conditions such as severe wind or wave action.

Physical Characteristics

Primary structural components: three or more pilings of wood, steel, or concrete

Preservative treatment: wood--creosote or salt (CCA or ACC); steel--tarsol or corrosion-resistant grade; concrete--not applicable

Minimum required penetration: function of the soil type at each site location; see Selection Guide and Figure 4-1

Basic configuration: piles are driven on an angle to the vertical and the tops are then connected with "thru-bolts" or wrapped with cable

Structural Requirements. A battered pile dolphin shall be designed to be capable of supporting the related equipment listed below and of resisting lateral loads impinged on the structure by environmental forces. Each pile must achieve the minimum penetration required--two-thirds the depth required of a single pile of the same material (Figure 4-1)--for the structure to attain fixity. Note that for most environmental conditions, excluding ice and collision, it is the soil and not the strength of the pile that is the critical factor. However, due to the configuration of the piles, the strength of a battered dolphin is only slightly greater than that of one fixated pile--depending on the amount of shear and moment transfer.

Related Equipment. A prefabricated metal or wood platform is required to support dayboards, batteries, signal equipment, and servicing personnel, as necessary.

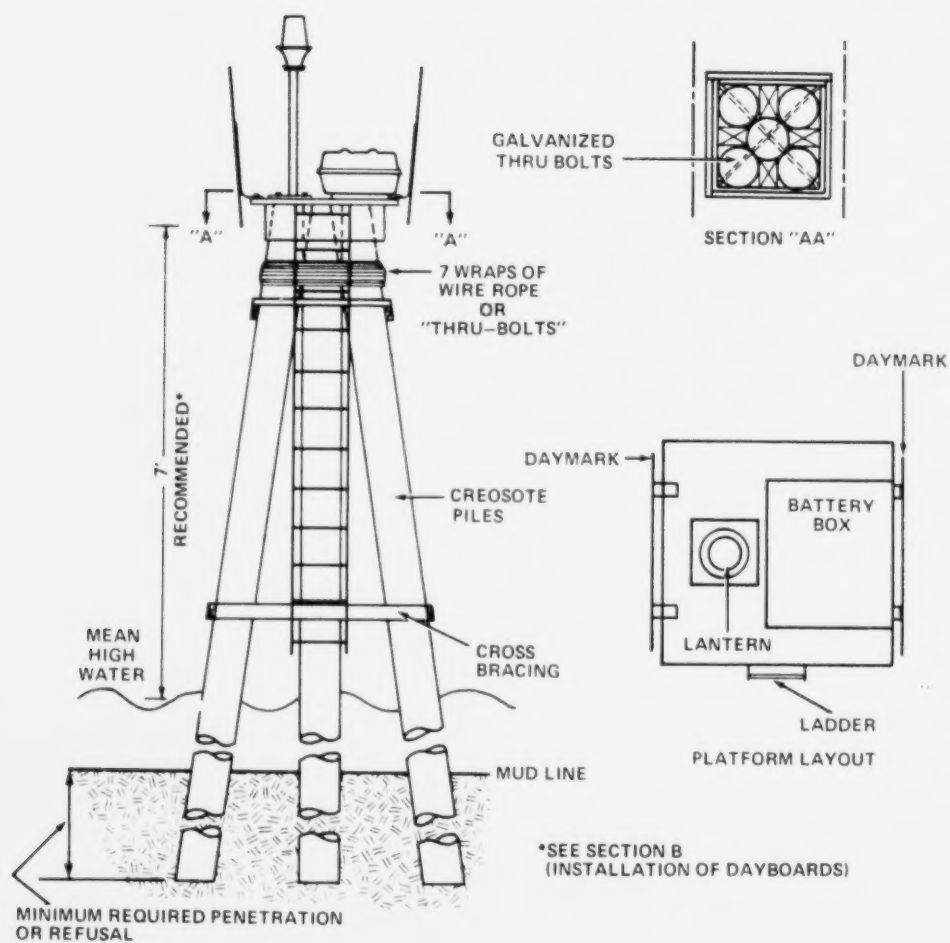


Figure 4-16. Multiple pile wood battered dolphin beacon structure (lighted).

Data Sheet 4-D(6). (cont'd).

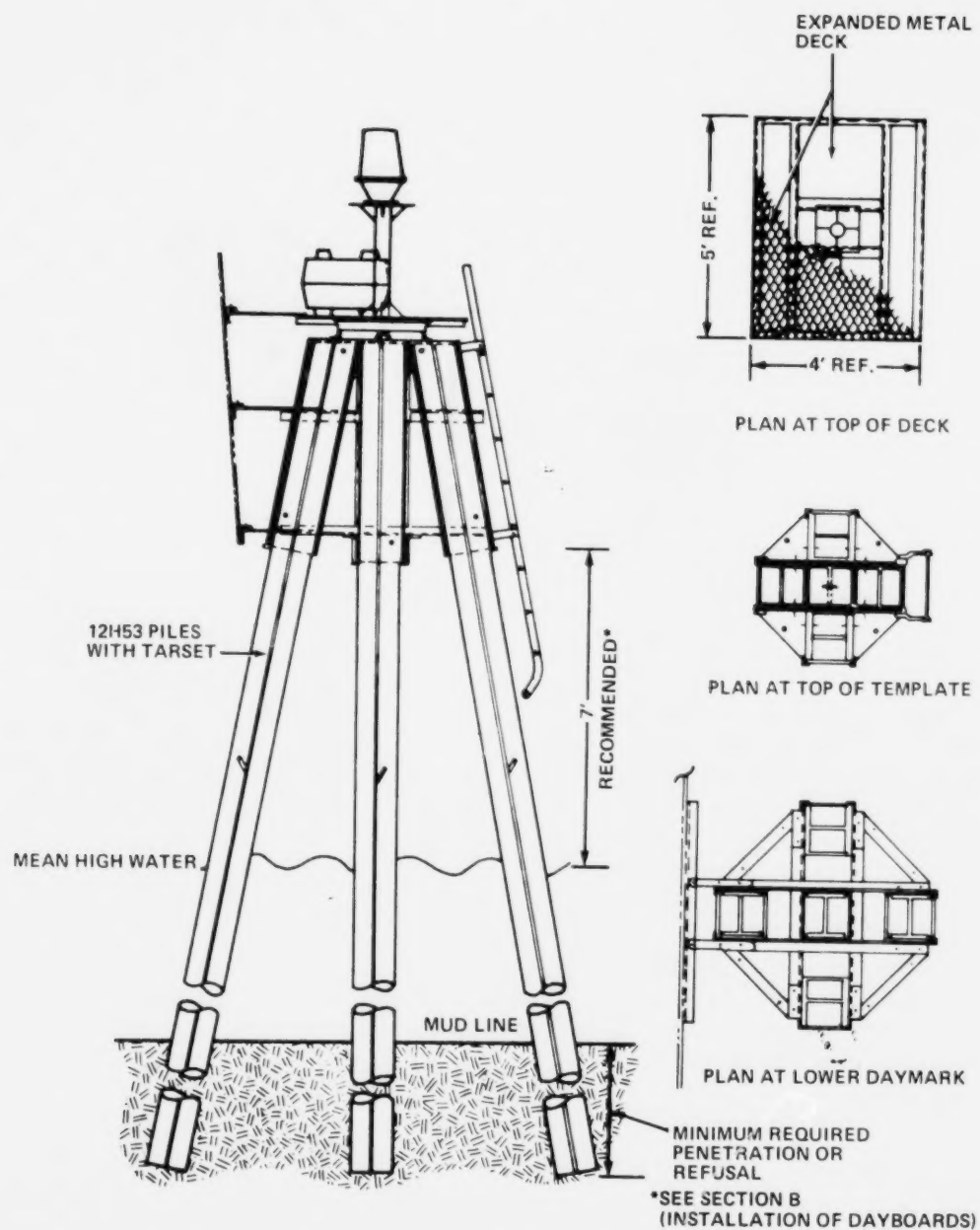


Figure 4-17. Multiple pile steel battered dolphin beacon structure (lighted).

Data Sheet 4-D(6). (cont'd).

MULTIPLE PILE--CLUSTER DOLPHIN



Function. A multiple pile cluster dolphin structure is used on marine sites for lighted or unlighted beacons when a single pile structure is not effective because of exposure conditions such as severe wind or wave action.

Physical Characteristics

Primary structural components: three or more pilings, usually wood

Preservative treatment: wood--creosote or salt (CCA or ACC)

Minimum required penetration: function of the soil type at each site location; see Selection Guide and Figure 4-1

Basic configuration: piles are driven vertically, skin-to-skin, and wrapped tightly together at various heights

Structural Requirements. A cluster pile dolphin supporting the related equipment listed below can generally withstand environmental loading in protected and semiexposed areas. Each pile must achieve fixity to attain the full structural capability of the cluster dolphin. The minimum penetration required for each pile is 25 percent greater than that required for a single pile of the same material in a soft bottom (HSM = 1 to 5), as shown in Figure 4-1. However, because shear transfer between the individual piles all along their lengths would be difficult to achieve, the strength of such a dolphin would be the sum of the cantilevered action of each of the piles. When considering this type of structure, it should be compared to a single steel pile--with special attention to strength, weight, and bearing surface.

Related Equipment. A prefabricated metal or wood platform is required to support dayboards, batteries, signal equipment, and servicing personnel, as necessary.

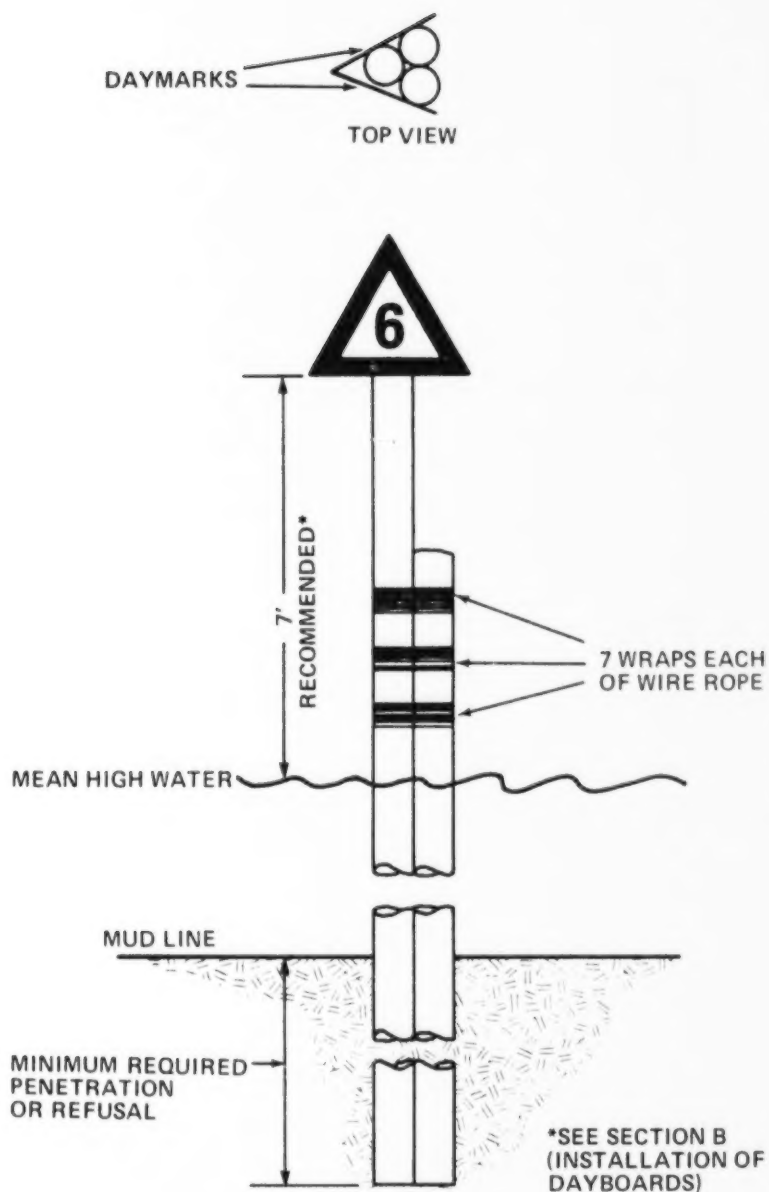
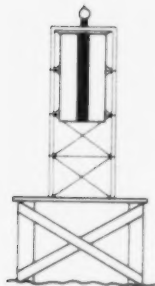


Figure 4-18. Multiple pile wood cluster dolphin beacon structure (unlighted).

Data Sheet 4-D(7). (cont'd).

MULTIPLE PILE--PLATFORM STRUCTURE



Function. A multiple pile platform structure is used on marine sites normally as a foundation for a skeleton tower when the focal height of the aid is over 30 ft, as with a range structure.

Physical Characteristics

Primary structural components: three or more pilings of wood, steel, or concrete

Preservative treatment: wood--creosote or salt (CCA or ACC); steel--tarsol or corrosion-resistant grade; concrete--not applicable

Minimum required penetration: function of the soil type at each site location; see Selection Guide and Figure 4-1

Basic configuration: piles are driven vertically and connected by a pile cap (platform); cross bracing can be added to achieve a more rigid foundation

Structural Requirements. Most multiple pile platform structures are used as foundations for skeleton towers. The vertical dead load of the tower must, therefore, be considered in the design of the foundation. The pile cap spreads the vertical and horizontal loads, along with the resulting overturning moment, to all piles in the group. The penetration required for each of the piles should be the same as that required for a single pile structure of the same material (Figure 4-1). Due to the critical nature of this type of structure, especially when used for ranges, penetration should not be reduced. The lateral spacing between each of the vertical pilings must be less than the penetration of each pile. If the minimum required penetration cannot be achieved, then at least 75 percent of the minimum required embedment must be achieved and cross bracing is required.

Related Equipment. A prefabricated metal or wood platform is required to support up to a 50-ft skeleton tower with dayboards, batteries, signal equipment, and servicing personnel, as necessary.

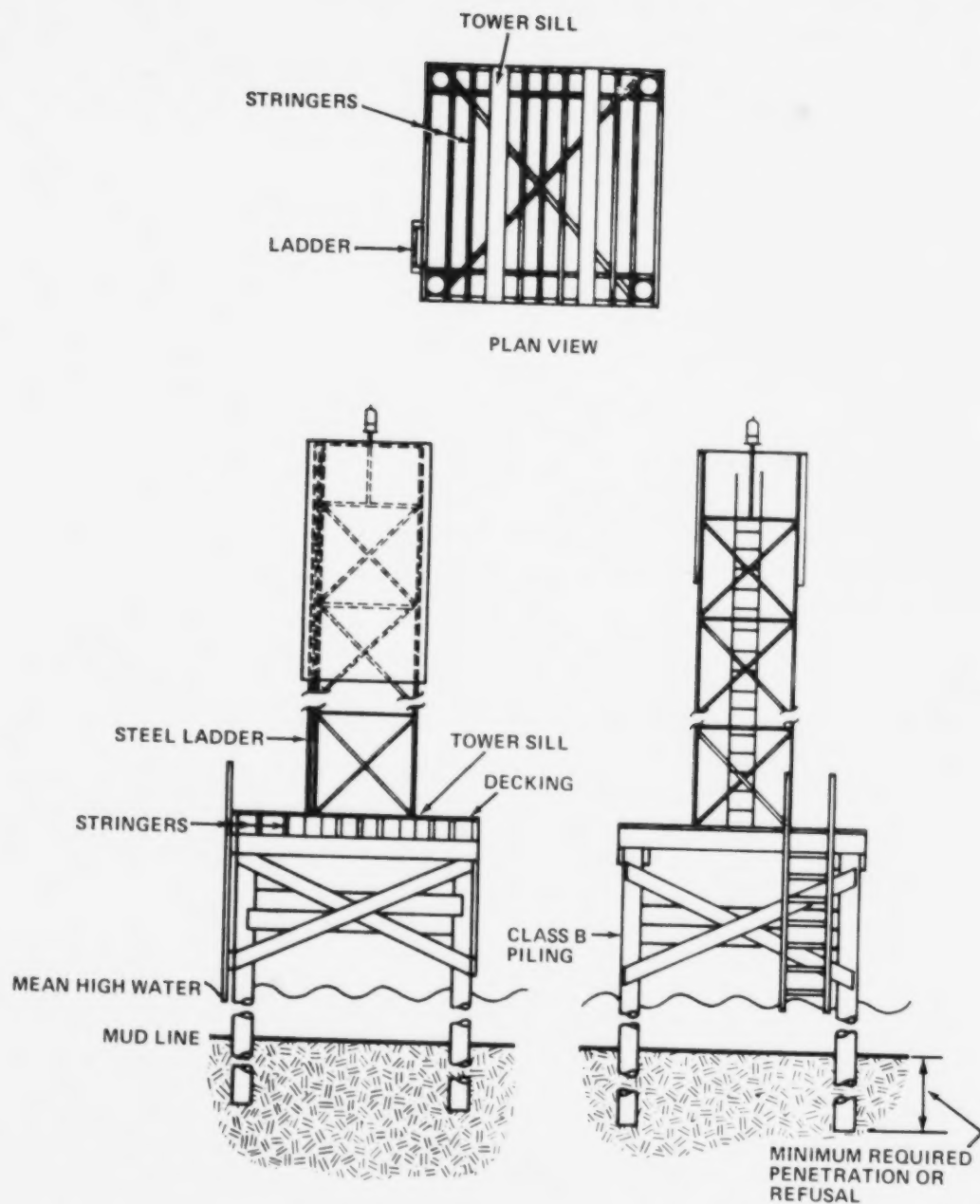


Figure 4-19. Multiple pile platform foundation.

Data Sheet 4-D(8). (cont'd).

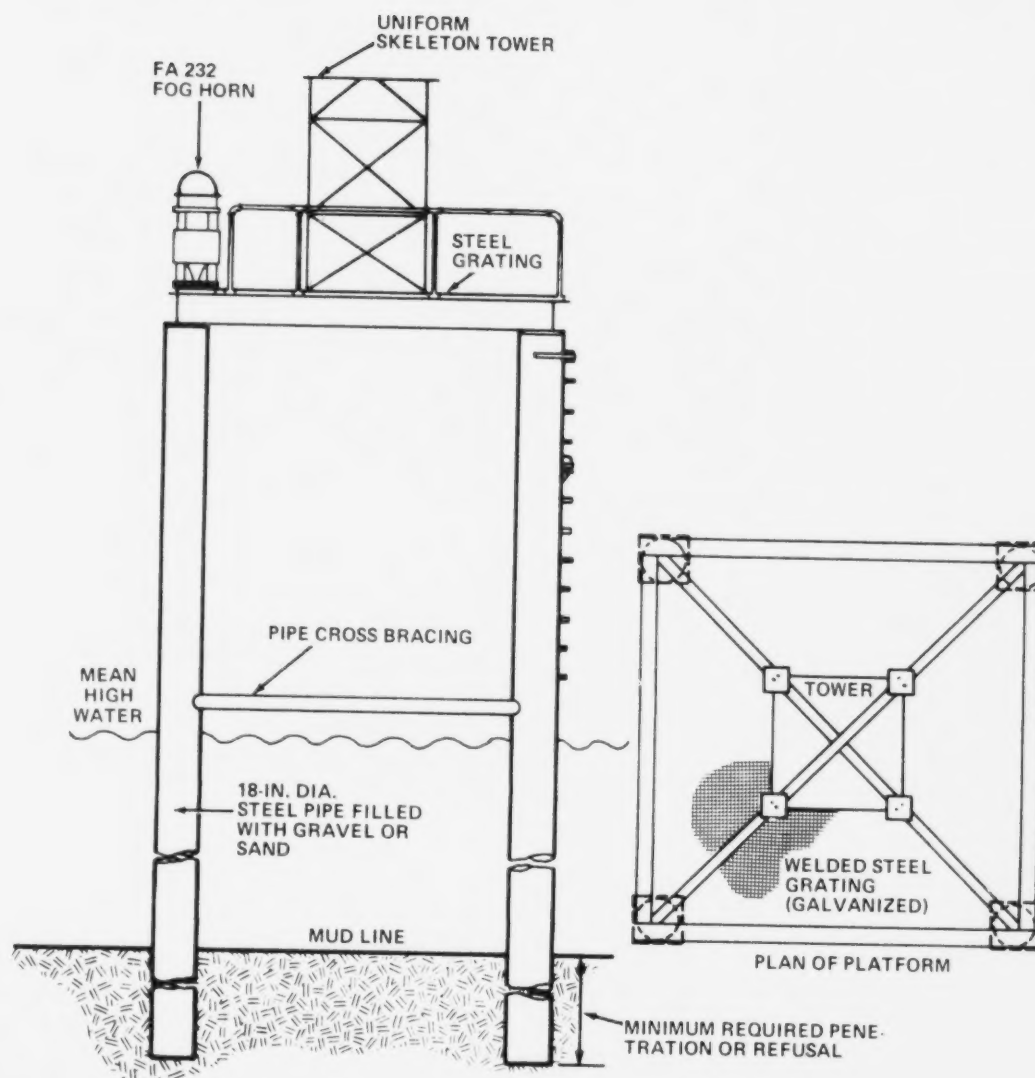
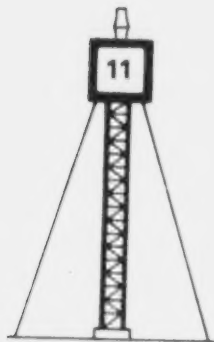


Figure 4-20. Multiple pile steel platform beacon structure.

Data Sheet 4-D(8). (cont'd).

GUYED SKELETON TOWER



Function. Where feasible, a guyed skeleton tower is an efficient and economical means to support signal equipment on land.

Physical Characteristics

Primary structural components: 1 1/4-in. diameter steel pipe, 3/16-in. guy wire
Preservative treatment: tarset or galvanized
Modular section height: 10 ft
Maximum height: 30 ft

Vertical configuration: similar to TV antenna tower
Horizontal configuration: 1-, 2-, and 3-ft equilateral triangles

Structural Requirements. A guyed skeleton tower shall be designed to be capable of supporting the signal equipment installed and of resisting lateral loads impinging on the structure by environmental forces. A guyed skeleton tower is secured with wire rope, which provides lateral support in addition to the vertical and lateral support provided by the foundation. The number, size, and location of guy wires depends on the type of foundation, the height of the tower, and the design loads that the tower must withstand. The normal arrangement of guy wires is shown in Figure 4-21. Concrete foundations or steel stakes embedded with grout are normally used to support the tower. The small size of this tower makes it impractical to provide a ladder which conforms to 29 CFR 1910. Therefore, this tower for a height of 20 ft or less is excluded from the ladder requirements of 29 CFR 1910. Safety procedures for these towers will be promulgated separately by District Commanders.

RECOMMENDED GUY WIRE ARRANGEMENT (Measurements in Feet)	
TOWER HEIGHT	DISTANCE (X) ***
10*	12 FT. EQUALS 3 ANCHOR LENGTHS
20*	16 FT. EQUALS 4 ANCHOR LENGTHS
30**	28 FT. EQUALS 7 ANCHOR LENGTHS

*For heights of 10 and 20 ft. only 3 guy wires are recommended
 **For 30 ft. height, 6 guy wires are recommended; 3 on 20 ft. level and 3 on 30 ft. level
 ***To measure the distance "x" from the base of the tower, lay down one of the guy anchors and mark off however many times is noted above

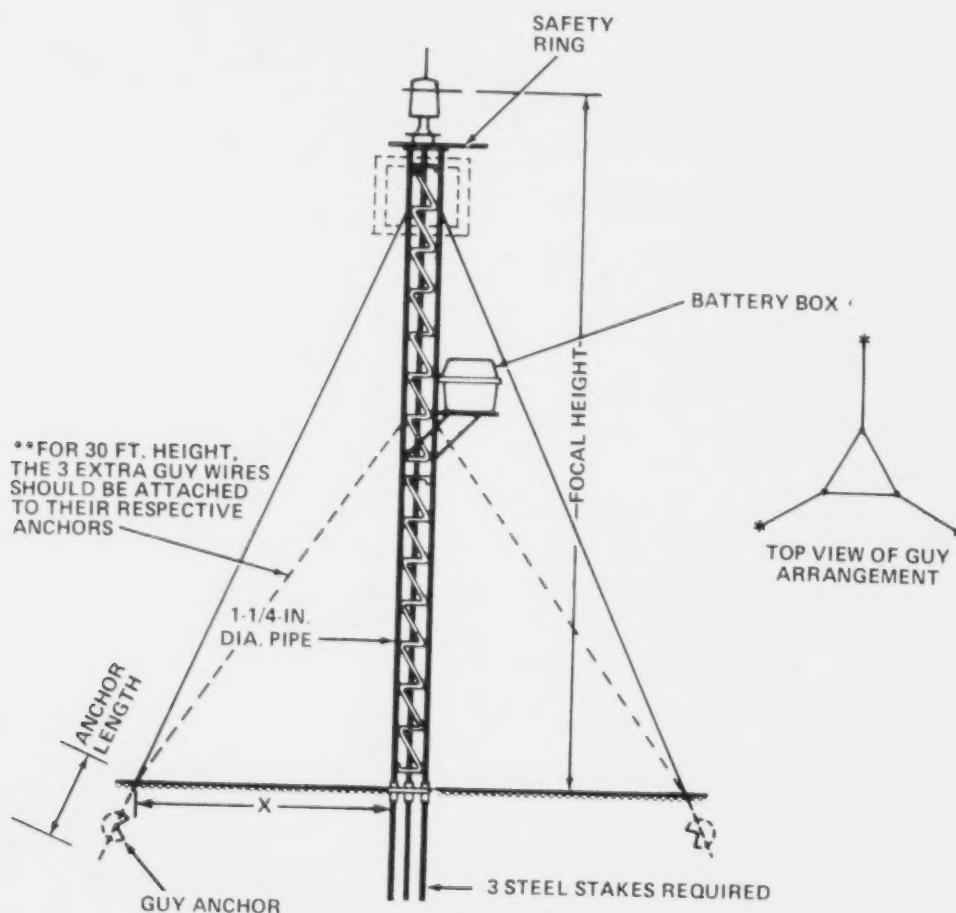


Figure 4-21. Single guyed skeleton tower.

Data Sheet 4-D(9). (cont'd).

FREE-STANDING SKELETON TOWER



Function. A free-standing skeleton tower is an efficient and economical means of supporting signal equipment on land or marine sites where it is not feasible to guy the structure. This type of tower is especially effective when the focal height needed for the operational requirements for the beacon is over 30 ft, as with range structures.

Physical Characteristics

Primary structural components: angle iron bracings

Preservative treatment: tarset or galvanized

Modular section height: 5 ft

Maximum height: 100 ft

Vertical configuration: uniform or tapered

Horizontal configuration: 2-ft through 10-ft squares

Structural Requirements: A free-standing skeleton tower must support the related equipment listed below (and be capable of supporting up to 5-mi range dayboards) and withstand environmental loading in protected, semiexposed, and exposed areas. On land, concrete foundations or steel stakes are usually used for support to resist the overturning moment developed by environmental forces. For marine applications, the towers are generally supported by caissons or multiple pile foundations.

Related Equipment. A steel grating platform is required to support batteries, signal equipment, and servicing personnel, as necessary.

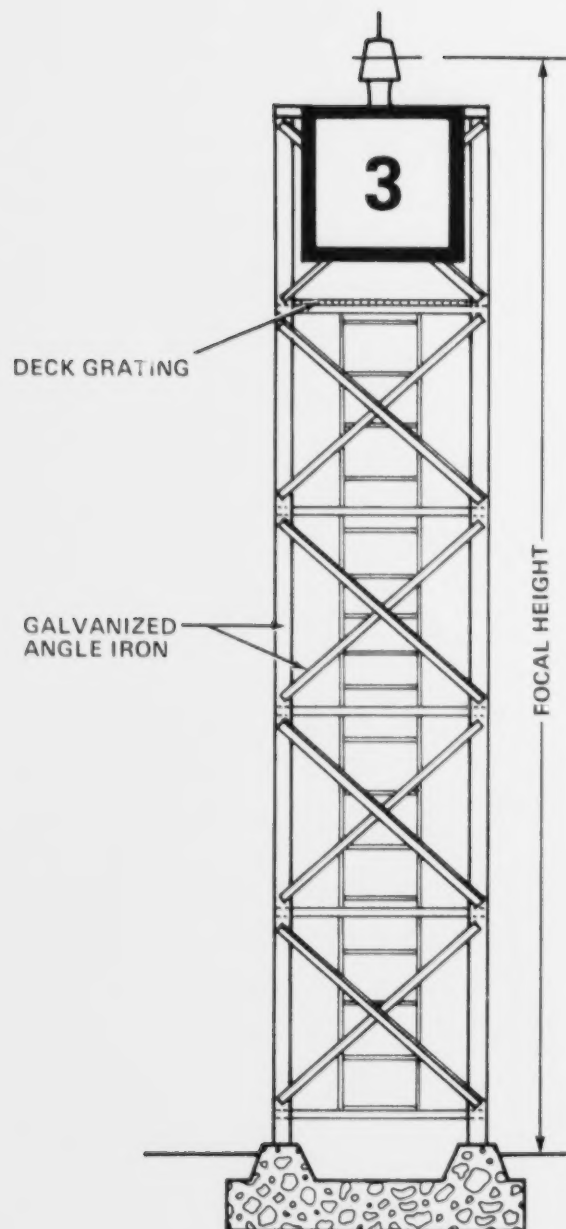


Figure 4-22. Free-standing skeleton tower with concrete footings on land.

Data Sheet 4-D(10). (cont'd).

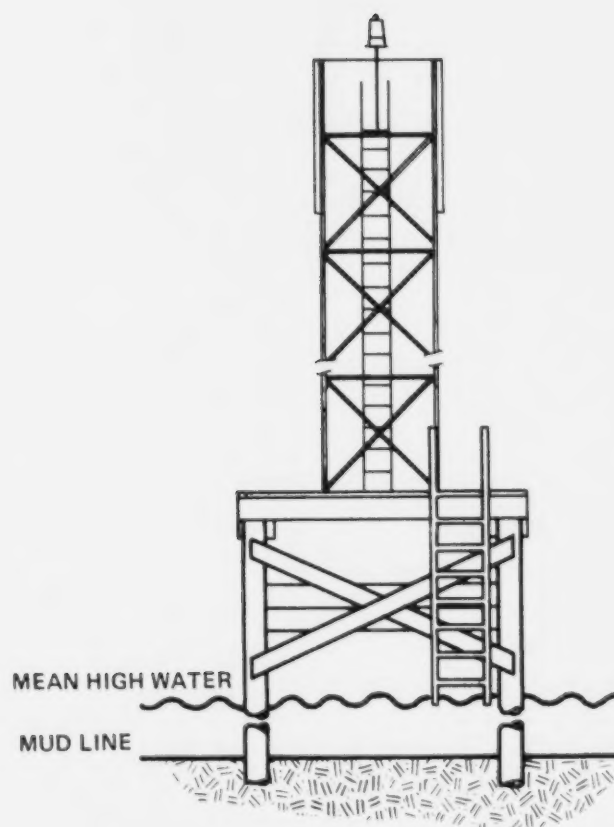
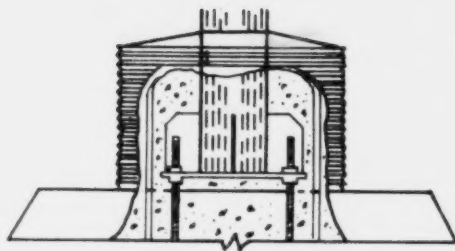


Figure 4-23. Free-standing skeleton tower on multiple pile platform.

Data Sheet 4-D(10). (cont'd).

CAISSON



Function. A caisson is a steel or reinforced concrete cylinder normally used

to support a skeleton tower. It is used when site conditions are severe, as with a heavy ice flow, or when the foundation is in an exposed area and a more permanent structure is needed. The cylinder serves as a form to hold rock, sand, or concrete.

Structural Requirements. A caisson foundation shall be designed to be compatible with the design loads of the superstructure and to withstand the environmental loading of semiexposed or exposed site locations.

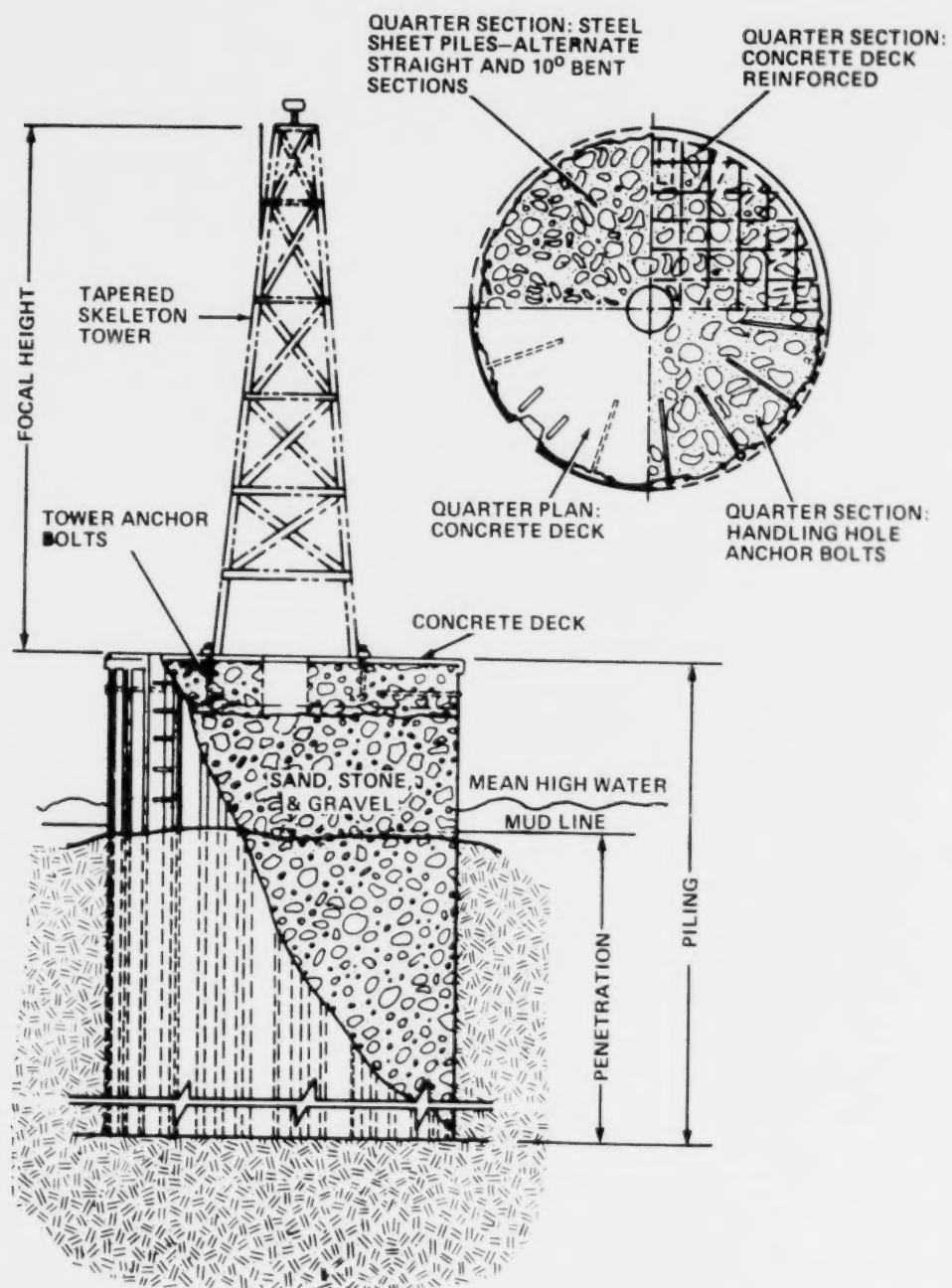
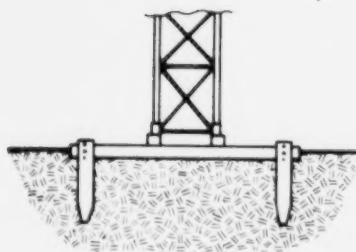


Figure 4-24. Caisson foundation.

Data Sheet 4-D(11). (cont'd).

MUD SILL



Function. A mud sill foundation is used to support beacon structures in locations where the underlying stratum is unstable, such as in a swampy area. This foundation is basically a specialized platform structure.

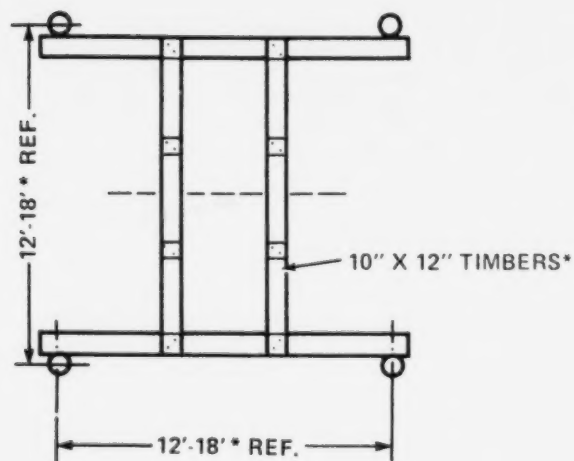
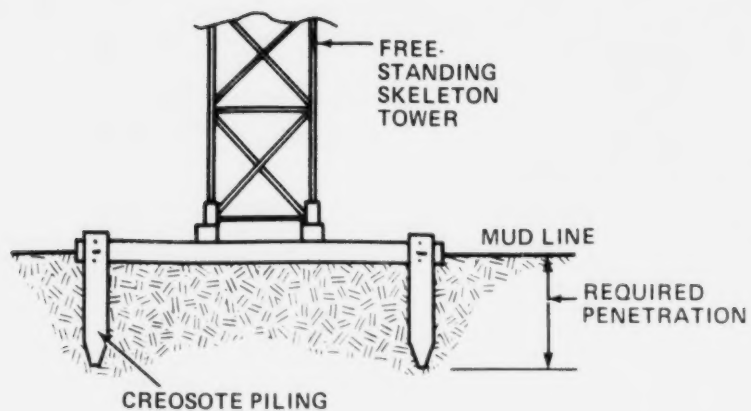
Physical Characteristics

Primary structural components: 10- by 12-in. timbers

Preservative treatment: creosote or salt

Horizontal configuration: 12 by 12 ft through 18 by 18 ft

Structural Requirements. A mud sill foundation is designed to distribute the structural load over a greater area than normal by increasing the lateral dimension when the height of the structure is increased. The bearing load is absorbed by the timbers, the shear forces are taken by the corner pilings, and the overturning moment is resisted by the width of the foundation. For special isolated cases, guy wires can be used to further resist the overturning moments.

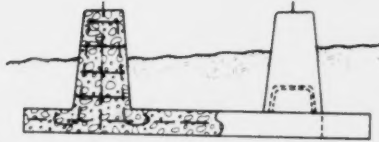


*LATERAL DIMENSIONS AND TIMBER SIZES
VARY DEPENDING ON HEIGHT OF TOWER.

Figure 4-25. Mud sill foundation.

Data Sheet 4-D(12). (cont'd).

CONCRETE FOUNDATION



Function. Concrete footings or concrete slab foundations are used to support structures on land.

Structural Requirements. Concrete footings and slabs shall be designed to be compatible with the design loads of the structure, the overturning moment developed by environmental forces, and the allowable bearing capacity of the soil.

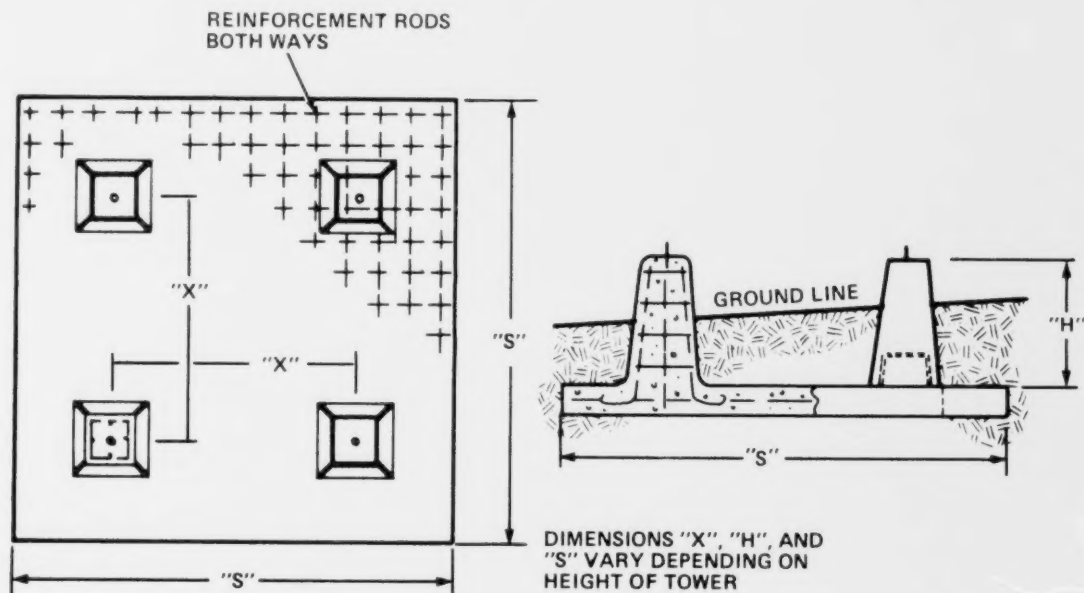


Figure 4-26. Concrete footings and slab foundation (tower).

Data Sheet 4-D(13). Concrete foundation.

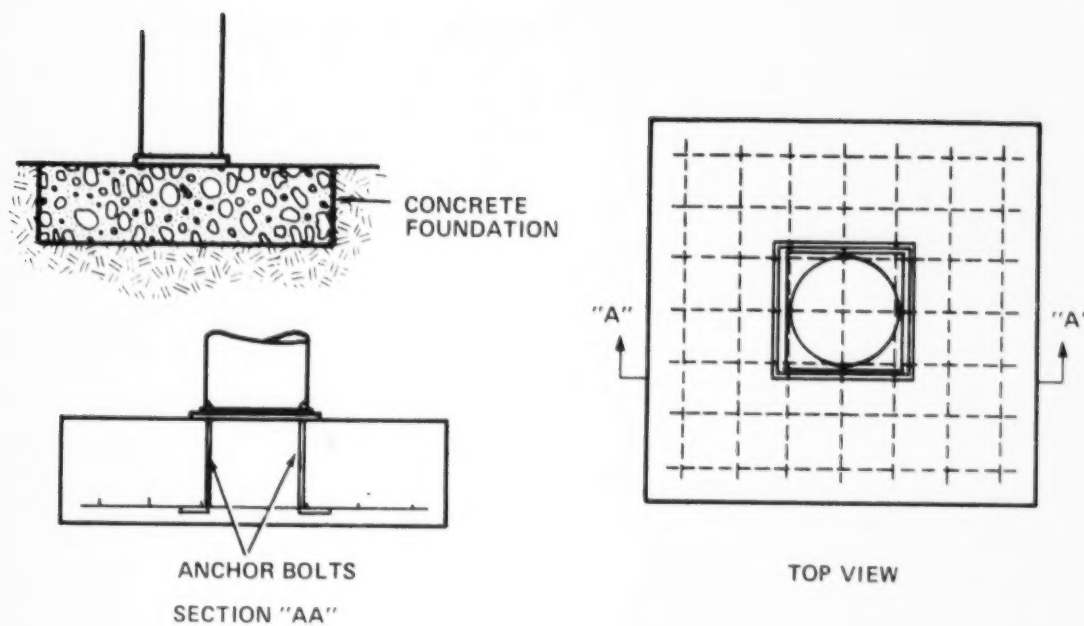


Figure 4-27. Concrete slab foundation (post).

Data Sheet 4-D(13). (cont'd).

RIPRAP

Physical Characteristics

Primary structural components: class A rock, at least 85 percent consisting of rocks that weigh more than 2 tons each; class B rock, at least 60 percent consisting of rocks that weigh more than 100 lb each; class C rock, rock smaller than class B, technically known as quarry waste

Function. Riprap is a collection of relatively large-sized rocks that are placed together to protect the beacon structure and the signal equipment which it supports against ice or flooding.

Structural Requirements. Riprap shall be designed to protect against the undermining and exposure of the beacon structure by properly using the weight and volume of the rock fragments to prevent washing away of the bottom.

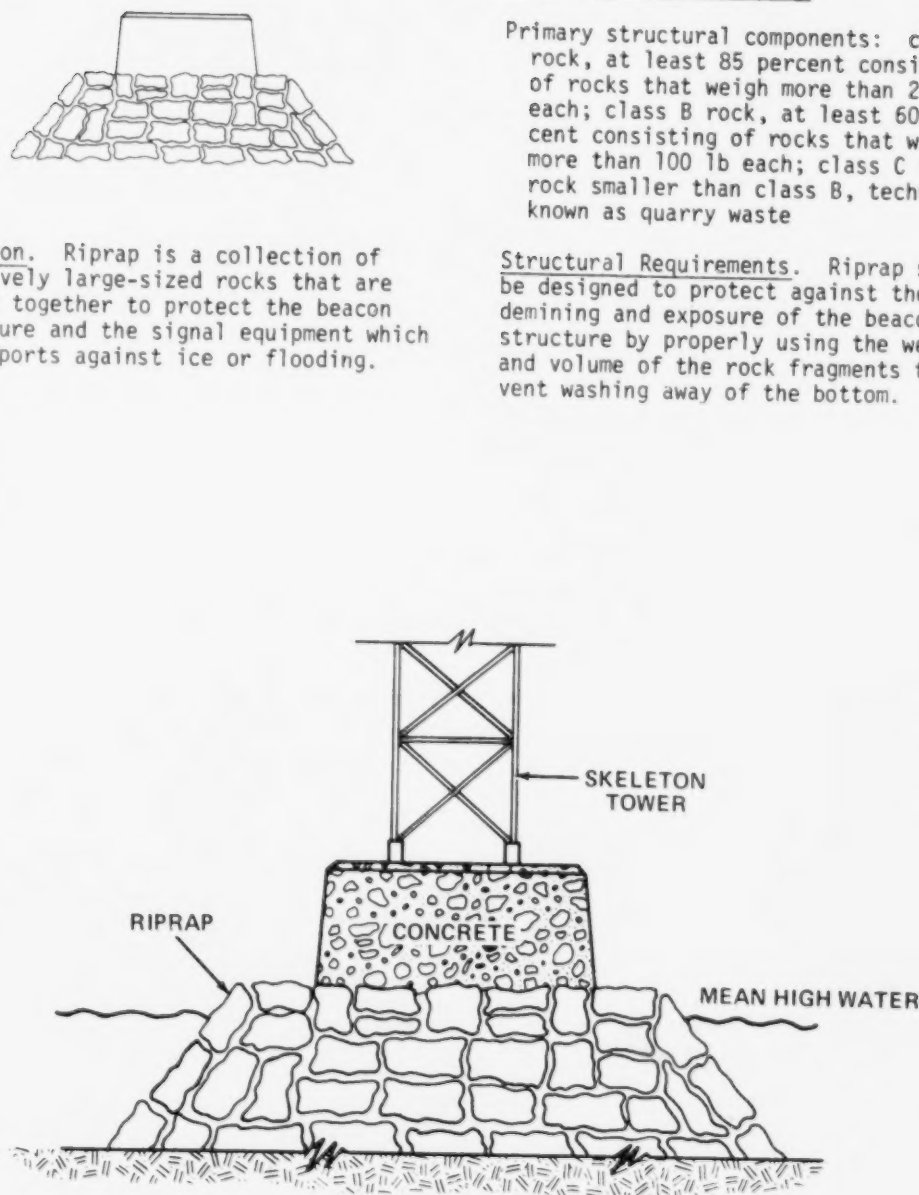
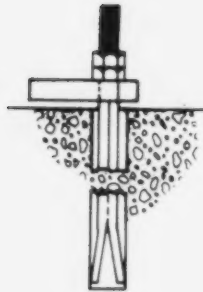


Figure 4-28. Riprap foundation.

Data Sheet 4-D(14). (cont'd).

STEEL STAKES



Function. Steel stakes can be used as an effective and low-cost foundation

to support skeleton towers on either a rock surface or soil. They can be used in lieu of a concrete foundation when the site location is not properly suited to concrete, such as on a rock surface. Holes are drilled into the rock and anchor bolts are secured to the base plate. Rapid-setting grout is used to embed the bolts to form a firm foundation.

Structural Requirements. Steel stakes must be designed to resist the overturning moments of the structure which are developed by environmental forces.

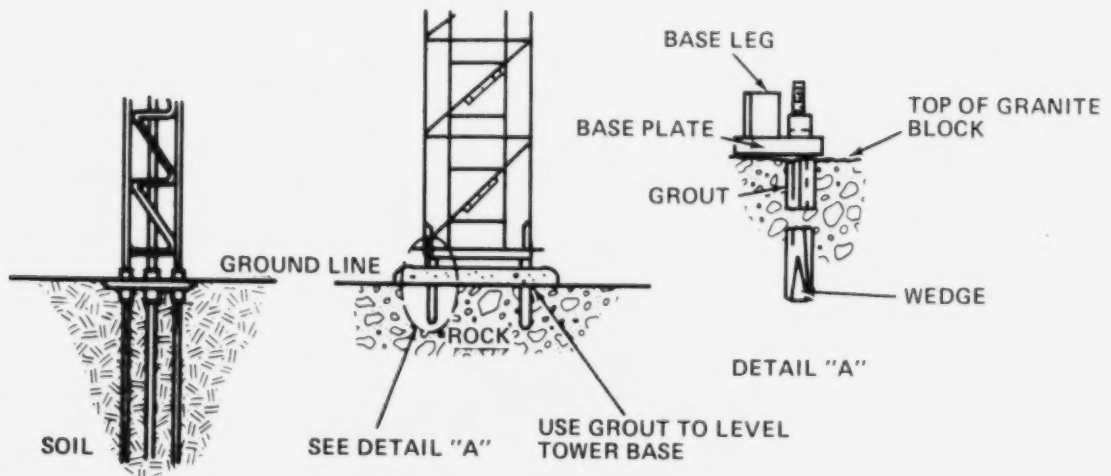
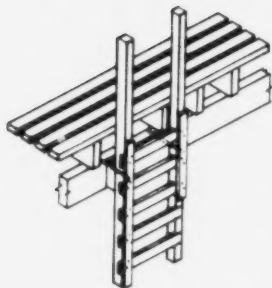


Figure 4-29. Steel stake foundation.

Data Sheet 4-D(15). Steel stakes.

LADDERS



Function. Ladders should provide servicing personnel with the safest practical conditions for climbing beacon structures. Each District Commander (ecv) determines the necessity and feasibility of equipping beacon structures with ladders. All ladders shall conform to the applicable sections of Title 29 of the *Code of Federal Regulations* (Chapter XVII, Part 1910), as directed by the *Safety Manual* (CG-405).

Physical Characteristics

Primary structural components: rungs or cleats

Minimum rung diameter: 3/4 in. (metal ladders); 1 1/8 in. (wood ladders)

Vertical distance between rungs, cleats, or steps shall not exceed 12 in. and shall be uniform throughout the length of the ladder

Minimum clear horizontal length of rungs or cleats: 16 in.

Structural Requirements. All ladders, appurtenances, and fastenings shall be designed to meet the following load requirements:

- The minimum design live load shall be a single concentrated load of 200 lb.
- The number and position of additional concentrated, live-load units of 200 lb each, as determined from anticipated usage of the ladder, shall be considered in the design. (Normally, two servicing

personnel may be on the ladder simultaneously.)

- The live loads imposed by persons on the ladder shall be considered to be concentrated at such points as will cause the maximum stress in the structural member being considered.

- The weight of the ladder and attached appurtenances (e.g., safety climbing device), together with the live load, shall be considered in the design of rails and fastenings.

Additional Data. On fixed ladders with a pitch of 90 degrees (vertical), the perpendicular distance from the centerline of the rungs to the nearest permanent object on the climbing side of the ladder shall be 30 in. The distance from the centerline of rungs, cleats, or steps to the nearest permanent object in back of the ladder shall be not less than 7 in.

Structures exceeding 20 ft in height shall be equipped with fixed metal ladders that conform to Section 27 in the *Code of Federal Regulations* cited above. In lieu of fixed ladders, portable wood and metal ladders (Sections 25 and 26, respectively) can be used to reduce vandalism. For structures less than 20 ft in height, portable ladders can be used instead of fixed ladders, but their use should not cause any additional safety hazard. A fixed wooden ladder is generally not recommended unless it has received adequate preservative treatment.

The small size of the guyed skeleton tower (Data Sheet 4-D(9)) makes it impractical to provide a ladder which conforms to 29 CFR 1910. Therefore, this type of tower for a height of 20 ft or less is excluded from the ladder requirements of 29 CFR 1910. Safety procedures for these towers will be promulgated separately by the District Commander.

Data Sheet 4-D(16). Ladders.

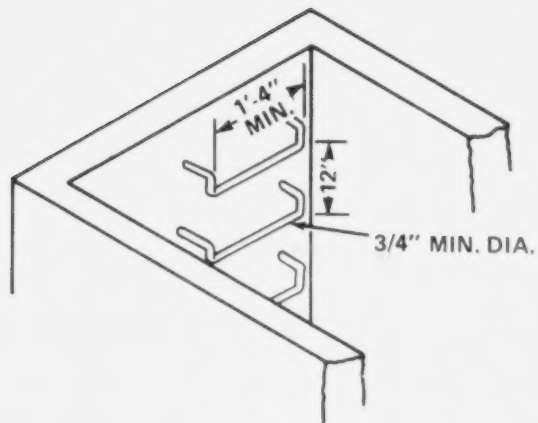


Figure 4-30. Rung design for individual rung ladders.

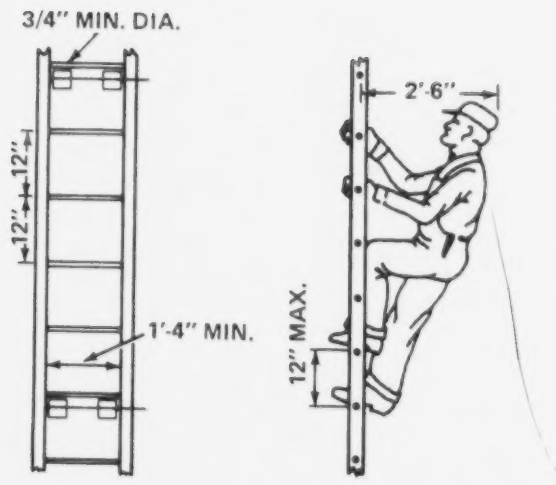
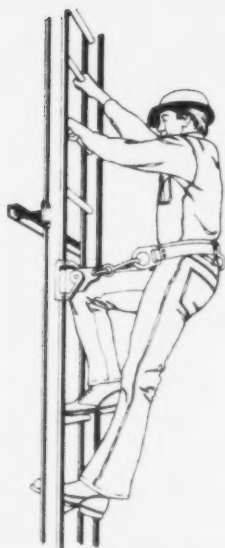


Figure 4-31. Standard dimensions for beacon structure ladder.

Data Sheet 4-D(16). (cont'd).

SAFETY CLIMBING DEVICE



Function. A safety climbing device should provide servicing personnel with the safest practical conditions for climbing beacon structures over 20 ft high.

Physical Characteristics. A safety belt connected to a ratchet or clamping unit slides along the rail during normal ascent or descent, but grips or locks to the rail if a climber slips or falls.

Structural Requirements. All ladder safety devices, such as those that incorporate lifebelts, friction brakes, and sliding attachments, shall meet the design requirements of the ladders which they serve.

Additional Data. All fixed ladders more than 20 ft in length shall be equipped with a rigid rail safety climbing device which meets the standards of Federal Specification RR-S-001301, Type I, and Title 29 of the *Code of Federal Regulations* (Chapter XVII, Part 1910, Section 27), as directed by the *Tower Manual* (CG-358) and the *Safety Manual* (CG-405), respectively.

Safety climbing devices shall not be installed on ladders where their placement or use would obviously complicate the situation, such as on a boat landing ladder or a ladder in the tidal range.

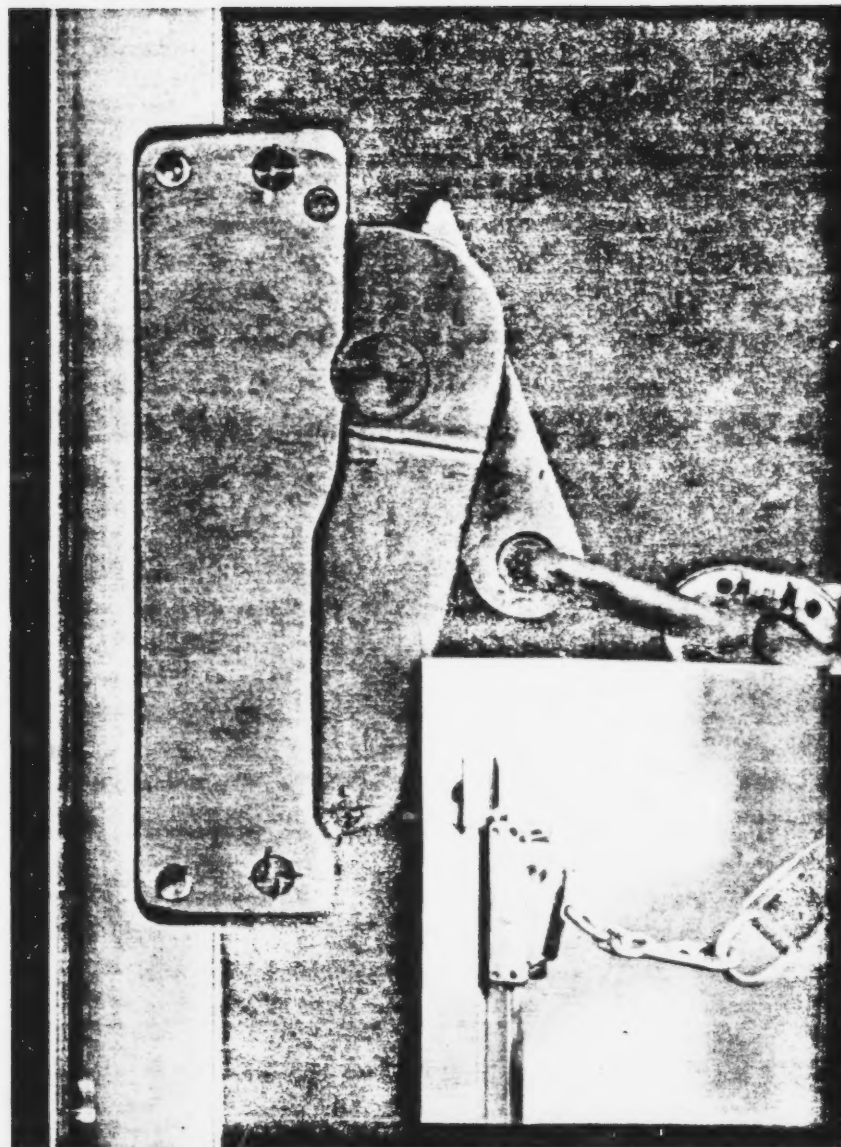


Figure 4-32. Typical safety climbing device.

Data Sheet 4-D(17). (cont'd).

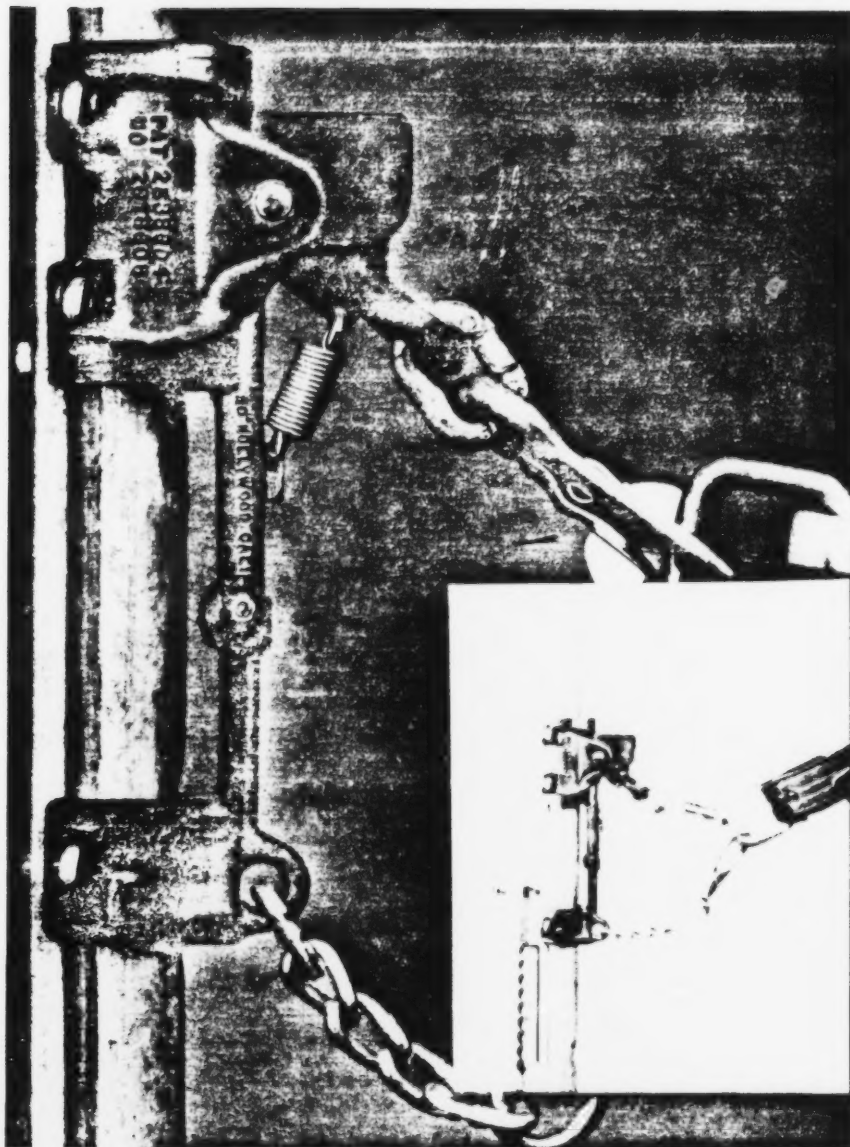
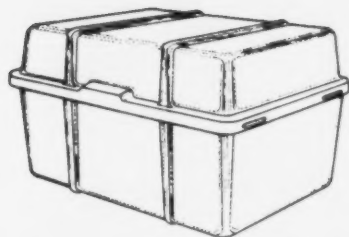


Figure 4-33. Typical safety climbing device.

Data Sheet 4-D(17). (cont'd).

BATTERY BOX



Function. The standard Coast Guard battery box holds any of the zinc air cell batteries currently in use.

Physical Characteristics

Material: ABS plastic with white acrylic exterior coating
Capacity: one 1,000-Ah series hookup
(two or more boxes may be required for capacities above 1,000 Ah)

Structural Requirements. The battery box shall be securely fastened to the platform so that it can withstand environmental forces.

Additional Data. The complete battery box comes with top and bottom, stuffing tube, and packing gland (NSN 6140-00-G00-3745). The following items are available for replacement purposes: top of battery box (NSN 6140-00-G00-3746); plastic stuffing tube--straight (NSN 5975-00-989-5046); plastic stuffing tube--angular, 45 degree (NSN 5975-00-989-5045); neoprene packing assembly (NSN 5330-00-202-2594).

Related Equipment

Cable, B/W, 2 conductor, #12, SO (NSN 6145-00-548-1225)

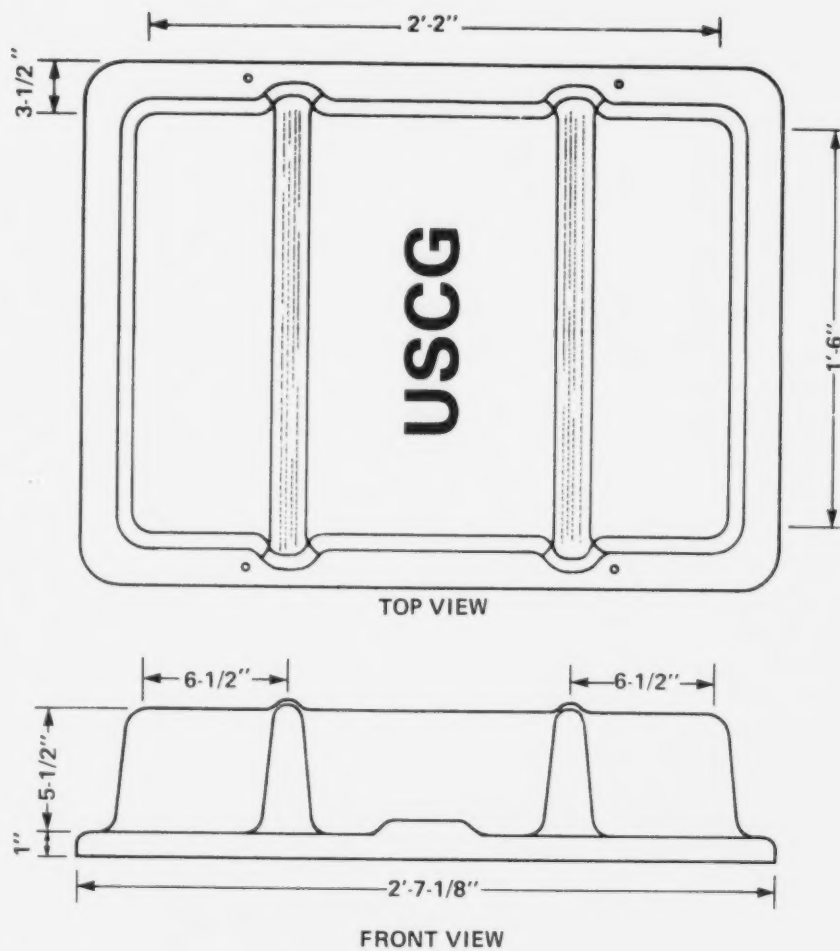


Figure 4-34. Battery box top dimensions.

Data Sheet 4-D(18). (cont'd).

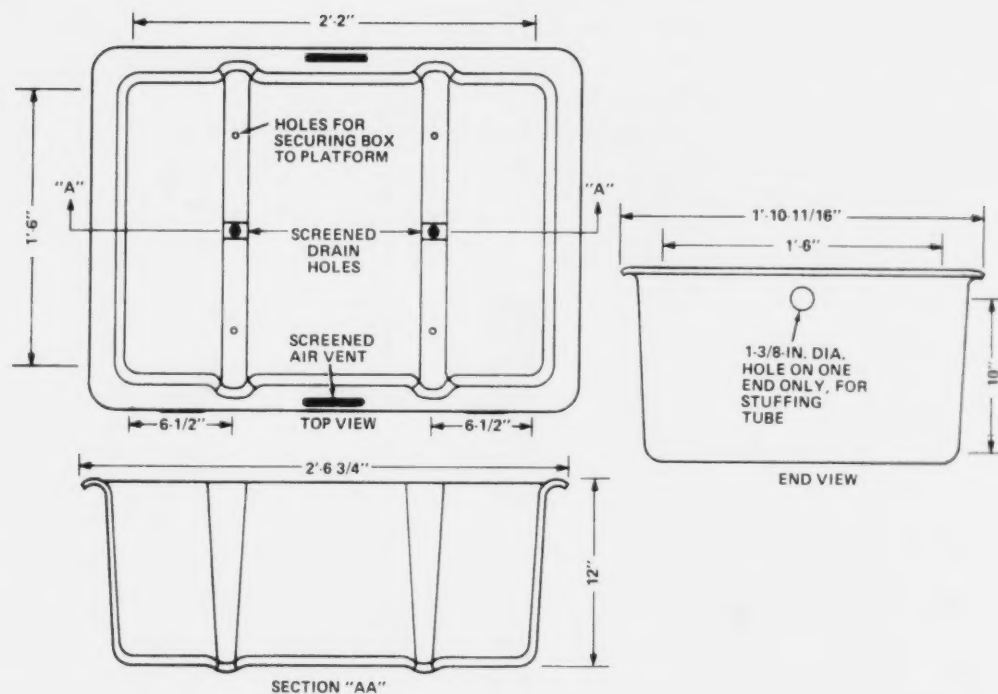


Figure 4-35. Battery box bottom dimensions.

Data Sheet 4-D(18). (cont'd).

CHAPTER 5 DAYBOARDS

Dayboards differ in size and markings depending on which marking system they represent (see CG-222-1, Chapter 1) and their specific function. This chap-

ter describes dayboard characteristics and provides guidance for selecting, preparing, inspecting, and maintaining dayboards.

A. SELECTION GUIDE

Designations. Prior to selecting a dayboard, it is helpful to understand the standard designations and operational parameters. Each dayboard has a designator--composed of a numeral followed by a group of letters--which indicates its dimension, shape, and color. The designator is constructed as follows:

- A NUMERAL gives the width of the dayboard in feet.

- The first LETTER refers to the shape or purpose of the dayboard:

- S - square
- T - triangle
- J - junction/bifurcation/obstruction
- M - mid-channel
- N - no lateral significance
- K - range
- C - crossing.

- The second LETTER represents the key color:

- R - fluorescent red
- G - fluorescent green
- W - white
- B - black.

- The third LETTER indicates the color of stripe (range dayboards only):

- R - fluorescent red
- G - fluorescent green
- W - white
- B - black.

- Additional information is shown by LETTERS placed after a dash (-):

- I - intracoastal waterway
- SY - yellow square on dayboard (dual purpose)
- TY - yellow triangle on dayboard (dual purpose).

As shown in Figure 5-1, a 6KRW-I designator indicates a 6 ft wide, fluorescent red range dayboard with a white center stripe and a yellow, reflective strip along the bottom edge, which shows

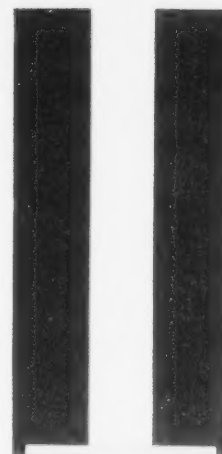


Figure 5-1. Sample 6KRW-I dayboard designator.

that it is for use on the intracoastal waterway.

A 4JR-SY designator indicates a 4-ft wide, fluorescent red and green, triangular dual-purpose junction dayboard with a yellow square, as shown in Figure 5-2. The dayboard marks a junction between the intracoastal waterway (ICW) and another waterway, with the dayboard position denoting the port side of the ICW and the starboard side of the other waterway.

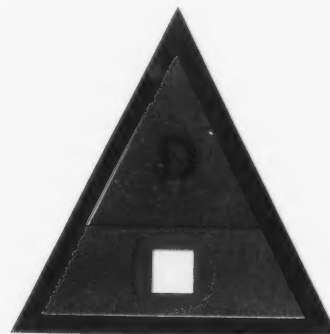
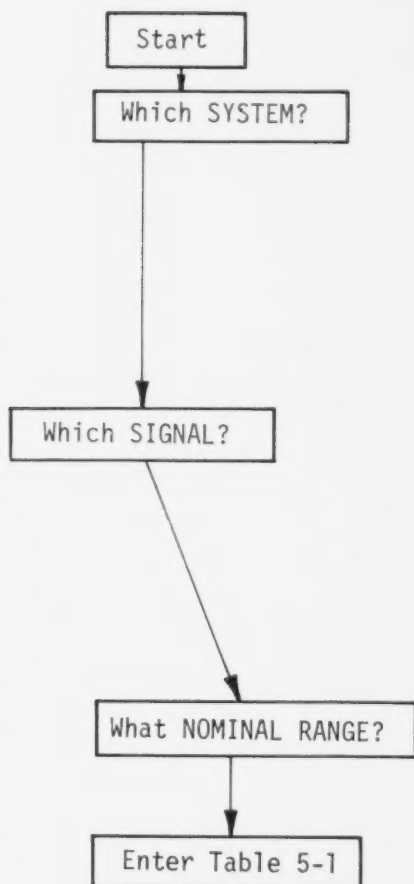


Figure 5-2. Sample 4JR-SY dayboard designator.

Nominal Ranges. As a mariner approaches a dayboard from a distance, it is first *detected* as an object apart from its surroundings (detection range). Upon coming closer to the dayboard, it can be *recognized* as a navigational aid with color and shape (recognition range). Finally, the particular aid can be *identified* when the mariner is close enough to read the numbers and letters on the dayboard (identification range).

The values for these three ranges will depend on the mariner's vision and the viewing conditions; however, the nominal range rating used in the classification of dayboards falls between their detection and recognition ranges. The identification range (in feet) for viewing dayboard characters is approximately 40 times the character height (in inches)--i.e., a 16-in. character can be identified at 640 ft or just over 200 yd.

Selection. Figure 5-3 is a functional diagram of the dayboard selection process.



Lateral: General Use, Western Rivers, or ICW

<u>Lateral Significance</u>	<u>No Lateral Significance</u>
Port/starboard	Special Purpose
Junction/Bifurcation/Obstruction	Warning
Mid-channel	Location
Range	Distance
Passing	Regulatory
Crossing	
1 nmi	
2 nmi	
3 nmi	
4 nmi (range daymarks only)	
5 nmi (range daymarks only)	

Figure 5-3. Selection procedure for dayboards.

Table 5-1
Reference Table for Dayboard Selection*

FUNCTION (NOMINAL RANGE [NMI])	<u>LATERAL SYSTEM</u>		
	<u>General Use</u>	<u>W. Rivers</u>	<u>ICW</u>
<u>Lateral Significance</u>			
Port and starboard (1)	5-D(1)	**	5-D(7)
Port and starboard (2)	5-D(2)	**	5-D(7)
Port and starboard (3)	5-D(3)	**	5-D(7)
Dual-purpose port and starboard (1,2,3)	5-D(9)	5-D(9)	5-D(9)
Junction (1,2,3)	5-D(4)	5-D(8)	5-D(7)
Dual-purpose junction (1,2,3)	5-D(10)	5-D(10)	5-D(10)
Mid-channel (1,3)	5-D(5)	**	5-D(7)
Range (1,2,3,4,5)	5-D(6)	5-D(6)	5-D(7)
Passing (1,2,3)	**	5-D(11)	**
Crossing (1,2,3)	**	5-D(11)	**
<u>No Lateral Significance</u>			
Special purpose (1,2,3)	5-D(12)	5-D(12)	5-D(12)
Warning (1,2,3)	5-D(13)	5-D(13)	5-D(13)
Location (1,2,3)	5-D(14)	5-D(14)	5-D(14)
Distance	**	5-D(11)	5-D(15)

*Numbers refer to data sheets which appear later in this chapter.

**Dayboards with this function are used only in the systems referred to by data sheet numbers.

B. PREPARATION AND INSTALLATION

Preparation. Dayboards shall be manufactured in accordance with Purchase Description No. 300 (available from Commandant (G-EOE)). Preparation of dayboards by units subsequent to the manufacturing stage shall be limited to the selection and application of letter, numerals, and dual purpose and intracoastal waterway markings, as indicated in paragraph 3.1.1 of the purchase description. Subject preparation shall follow the size, color, and location guidelines for these markings as depicted on the data sheets

Installation. Dayboards shall be fastened to their support structures in such a way as to meet or exceed a lifetime of 2 yrs. or as specified in the applicable District

drawings. Common fasteners acceptable for this purpose are listed in Table 5-2.

Base Material. The base material for dayboard construction shall be either 3/8-in. or a 1/2-in. AC exterior grade plywood (Group 3), manufactured in accordance with (American Plywood Asso.) U.S. Product Standard 1-74. The plywood cutting patterns for dayboards are contained in Data Sheet 5-D(16) of this chapter. Should local conditions within a district be such that AC exterior grade plywood would not survive exposure for the required two (2) years, District (ecv) may grant special approval for the use of overlay plywoods (meeting the requirements of USPS 1-74) in lieu of the AC exterior grade.

Table 5-2

Dayboard Support Structure Fasteners

<u>Structure</u>	<u>Fastener</u>	<u>Notes</u>
Wood	Nails	Minimum size 8d galvanized Minimum number, 4 per 8-sq ft board area
	Lag screw	Minimum size 3/8 in. galvanized Minimum number, 2 per 8-sq ft board area
Concrete or steel (with platform)	Through bolts	1/2 in. X 13 in. NC galvanized
	Carriage bolts	1/2 in. X 13 in. NC aluminum (Fed Spec QQ-A-270(a)(1) amended for aluminum alloy 6061-T6)
	U bolts or J bolts	Minimum number, 2 per 8-sq ft board area 3/8 in. X 3 in. galvanized Minimum number, 2 per 8-sq ft board area

C. INSPECTION, MAINTENANCE, AND REPAIR ON STATION

Inspection. Dayboards shall be inspected at least annually. Dayboard surface and backing materials deteriorate due to the effects of weathering--wind, rain, freezing temperatures, and sunlight cause delamination (separation), cracking, peeling, and fading. Attention shall be given to these conditions when inspecting according to the following guidelines.

Backing Material. Delamination of material should not have progressed over more than 25 percent of the backing material surface area. Material should not be sufficiently warped to visibly detract from the signal presented to the mariner, nor should it be softened or otherwise deteriorated around mounting points to the degree that the board may come loose in a storm that may be expected in any given year in the area.

Fluorescent Films, Retroreflective Numerals, Letters, and Borders. Delamination of this material should not have progressed over more than 10 percent of the surface area of the film. Material should not be cracked, checked, or abraded so as to provide a dull or roughened top surface. Material should not have peeled (loss of adhesion with material to which attached) over more than 10 percent of the surface area and should not be faded or otherwise have

changed color beyond the limits shown in Figure 5-4.

Replacement or Repair. The dayboard shall be replaced if any of the deterioration noted above is observed, or if for any reason it cannot function as intended (including a display of the proper color) until the next regularly scheduled visit. Onsite repairs are permitted if they do not detract from the intended signal function of the dayboard. Paint does not provide the same signal characteristics as fluorescent film and painting of dayboards is, therefore, specifically prohibited.

Measurement of Fluorescent Material Degradation. Fluorescent materials provide above-average visual stimulus by converting a portion of unusable sunlight (ultraviolet) to light that we can see. This very process degrades (uses up) the fluorescent dyes in the material and, thus, it is very likely to change color (fade) during its lifetime. The amount of color change is dependent upon the geographical location of the dayboard and its orientation to the sun. The daymark samples in Figure 5-4 show the normal color change associated with fluorescent materials. This figure should be used in the inspection of color as described above.



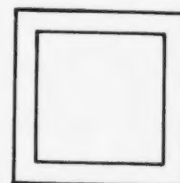
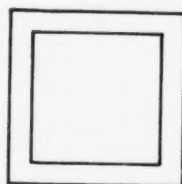
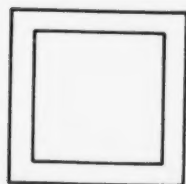
NEW
MATERIAL



1/2 LIFE
REMAINING



1/4 LIFE
REMAINING



COLORS NOT AVAILABLE



REPLACE



OVERDUE

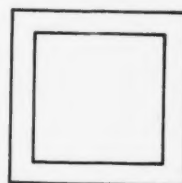
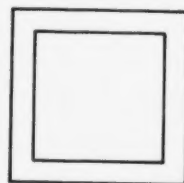


Figure 5-4. Sample dayboards showing color change of fluorescent materials.

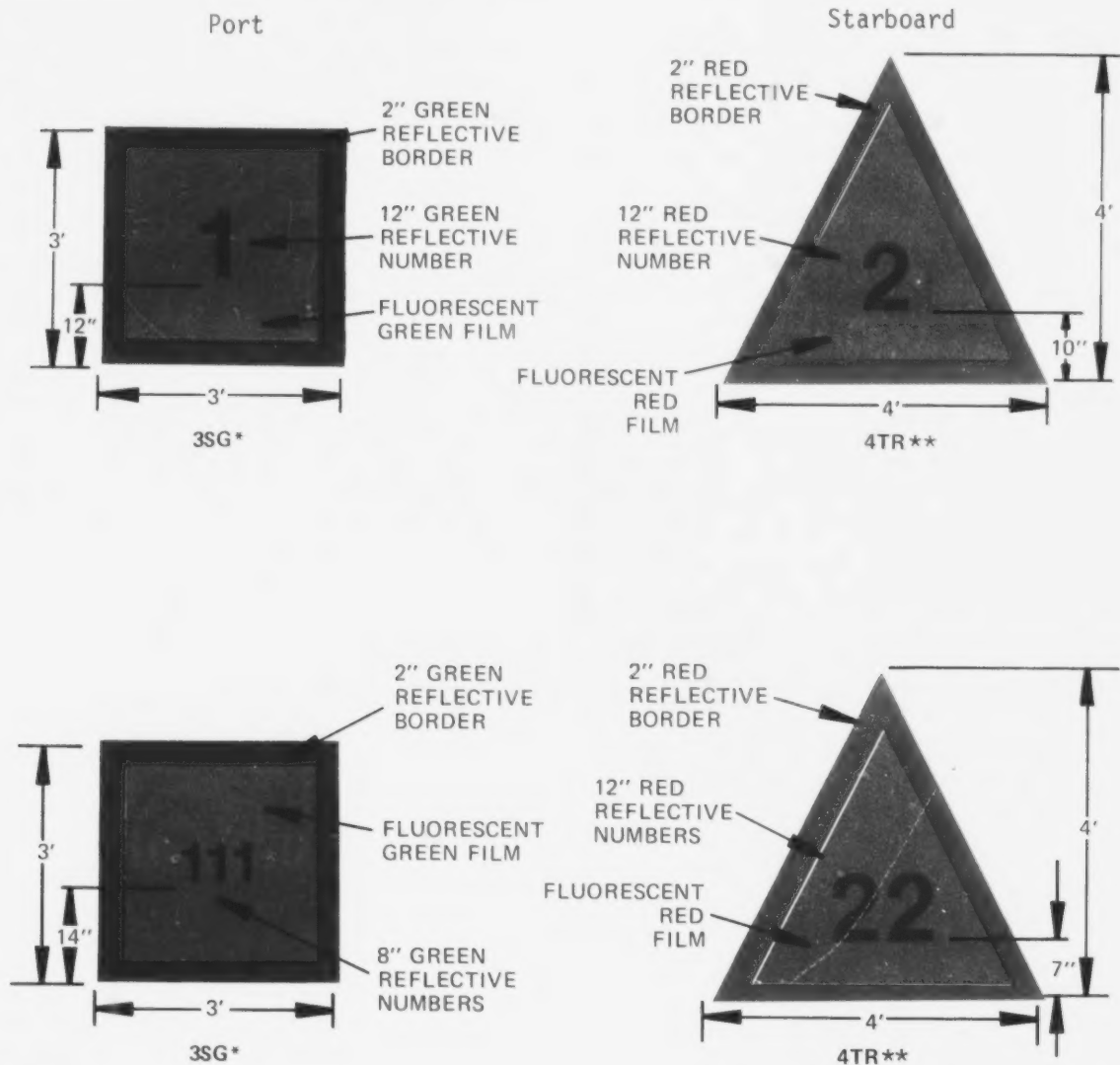
D. GENERAL DESCRIPTION DATA SHEETS

LATERAL GENERAL USE PORT AND STARBOARD MARKERS

System: Lateral general use

Function: Laterally significant port and starboard markers

Nominal Range: 1 nmi



*For 2 numerals, use 12" numbers at a height of 12" off base.

**For 3 numerals, use 8" numbers at a height of 12" off base.

Figure 5-5. Lateral general use port and starboard markers.

Data Sheet 5-D(1). Lateral general use port and starboard markers (nominal range, 1 nmi).

LATERAL GENERAL USE PORT AND STARBOARD MARKERS

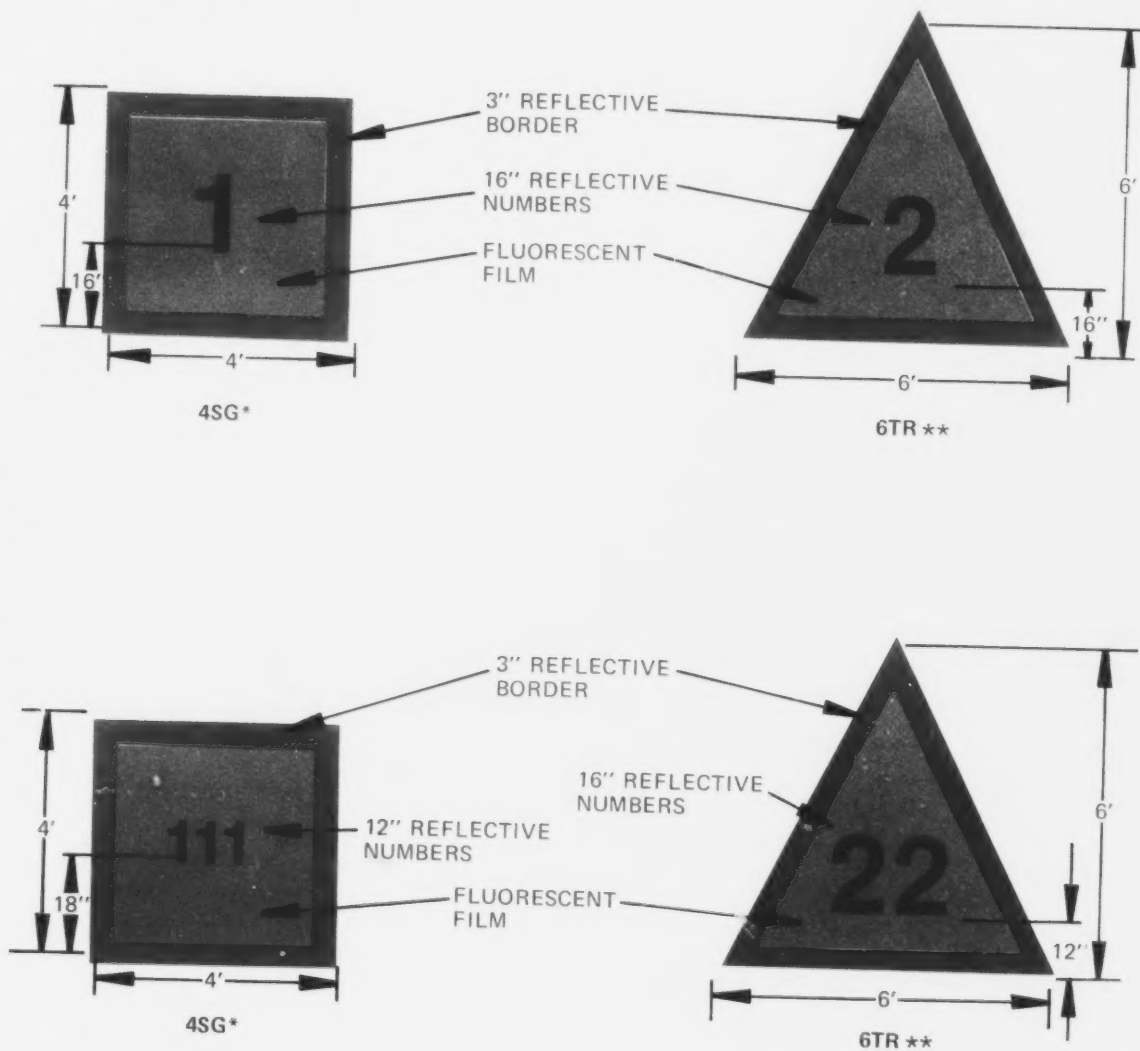
System: Lateral general use

Function: Laterally significant port and starboard markers

Nominal Range: 2 nmi

Port

Starboard



*For 2 numerals, use 16" numbers at a height of 16" off base.
 **For 3 numerals, use 12" numbers at a height of 12" off base.

Figure 5-6. Lateral general use port and starboard markers.

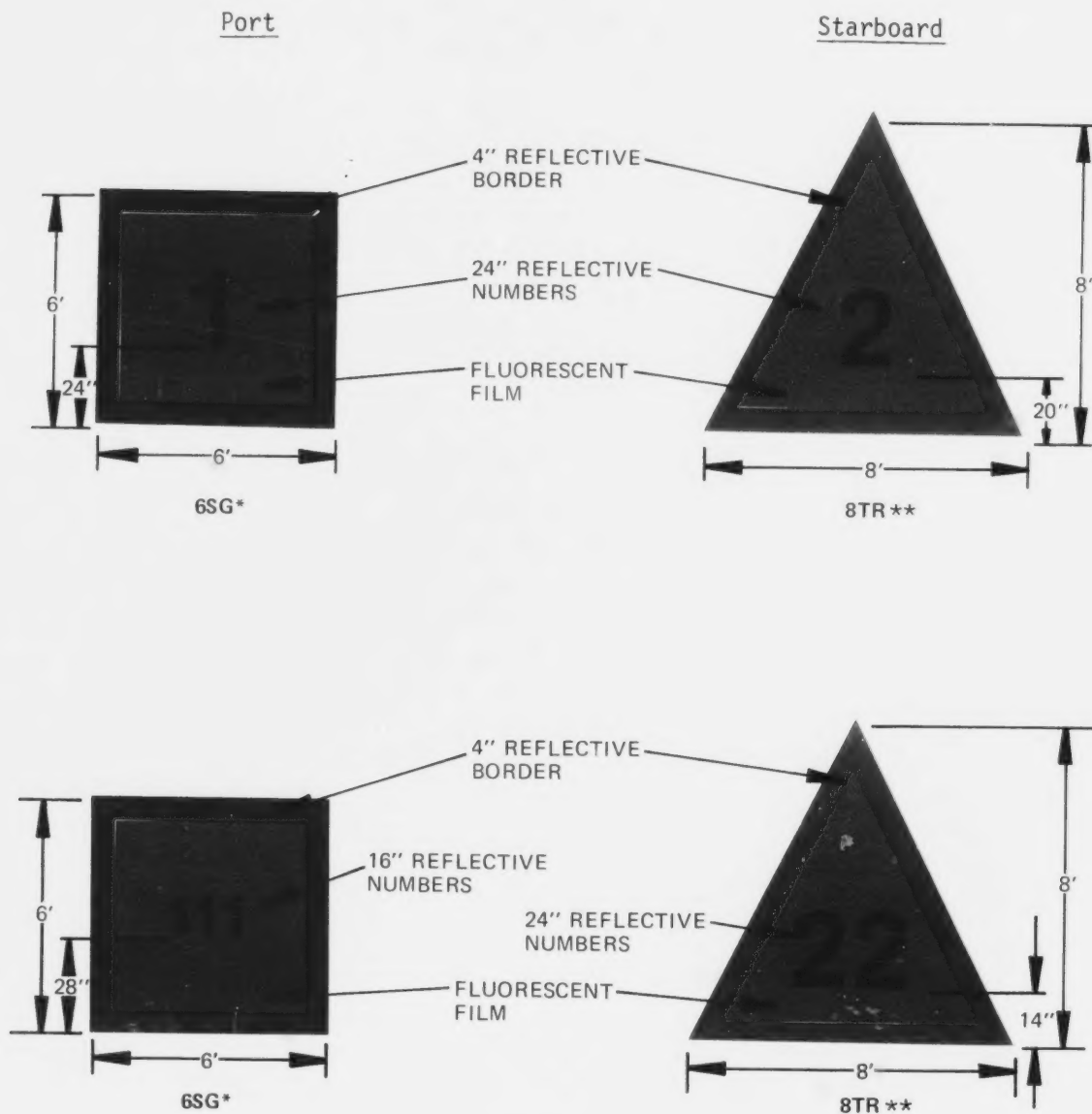
Data Sheet 5-D(2). Lateral general use port and starboard markers (nominal range, 2 nmi).

LATERAL GENERAL USE PORT AND STARBOARD MARKERS

System: Lateral general use

Function: Laterally significant port and starboard markers

Nominal Range: 3 nmi



*For 2 numerals, use 24" numbers at a height of 24" off base.
 **For 3 numerals, use 16" numbers at a height of 14" off base.

Figure 5-7. Lateral general use port and starboard markers.

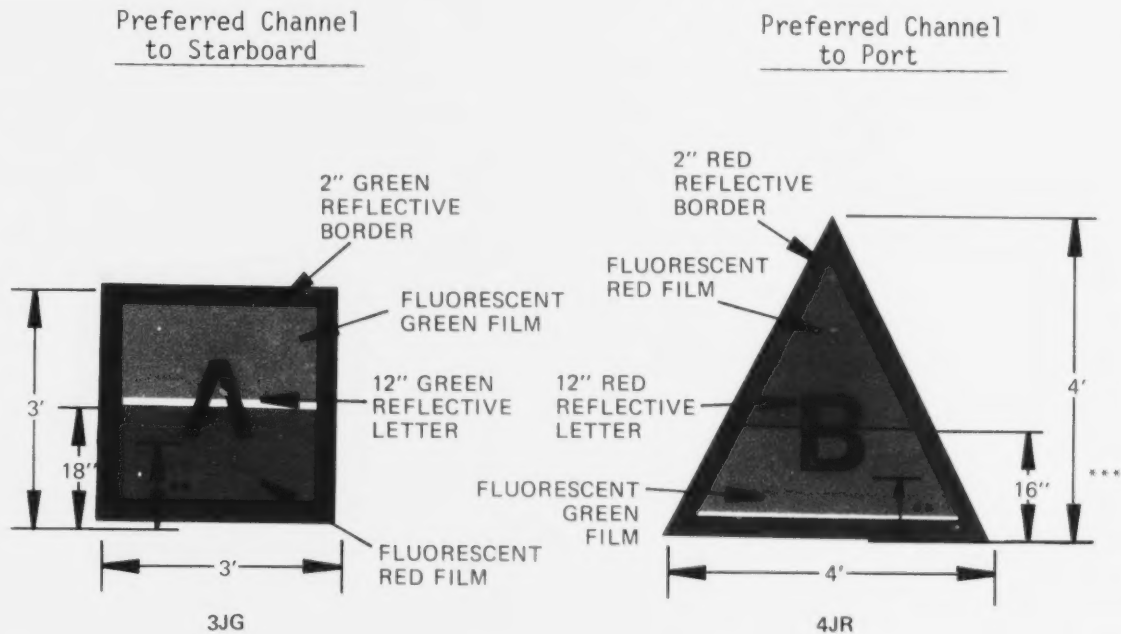
Data Sheet 5-D(3). Lateral general use port and starboard markers (nominal range, 3 nmi).

LATERAL GENERAL USE JUNCTION MARKERS

System: Lateral general use

Function: Laterally significant junction markers

Nominal Range: 1 nmi*



*For 2- and 3-nmi ranges, use the dimensions in Table 5-3.

**Vertically center all letters on the fluorescent color division. For two letters, use 12-in. letters on 3JG, 8-in. letters on 4JR.

***See Table 5-3, column 3.

Figure 5-8. Lateral general use junction markers.

Data Sheet 5-D(4). Lateral general use junction markers (nominal ranges, 1, 2, and 3 nmi).

Table 5-3
Dimensions for 2- and 3-nmi Nominal Range Dayboards
for Lateral General Use Junction Markers

<u>Nominal Range (nmi)</u>	<u>Width Square (ft)</u>	<u>Height of Dividing Line (in.)†</u>	<u>Border Width (in.)</u>	<u>1 Letter Size (in.)</u>	<u>2 Letter Size (in.)</u>
2	4		3	16	16
3	6		4	24	24
	<u>Width Triangle (ft)</u>				
2	6	24	3	16	12
3	8	32	4	24	16

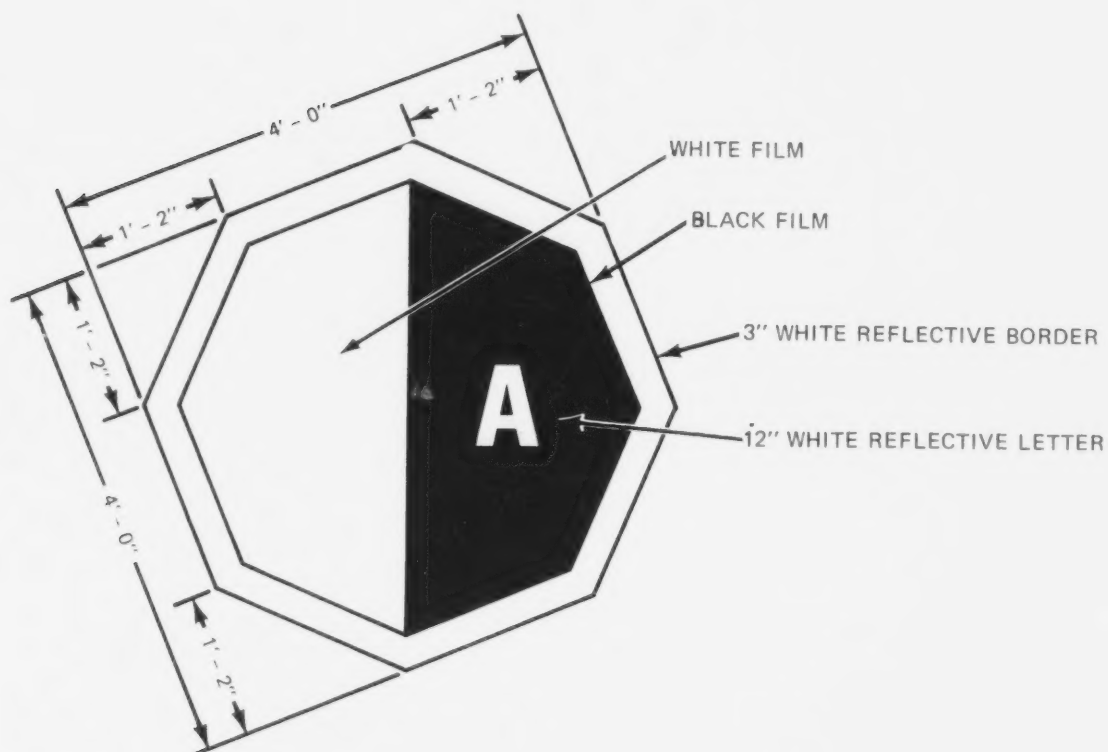
†For triangular boards only, this is the height of the dividing line between fluorescent materials above the base.

LATERAL GENERAL USE MID-CHANNEL MARKERS

System: Lateral general use

Function: Laterally significant mid-channel markers

Nominal Range: 1 nmi*



4MB
GENERAL USE SERIES

*If a larger daymark is required, use the following dimensions (which give a 3-nmi nominal range): 8' octagon, 6" border, 16" single letter, or 12" double letters.

Figure 5-9. Lateral general use mid-channel markers.

Data Sheet 5-D(5). Lateral general use mid-channel markers (nominal ranges, 1 and 3 nmi).

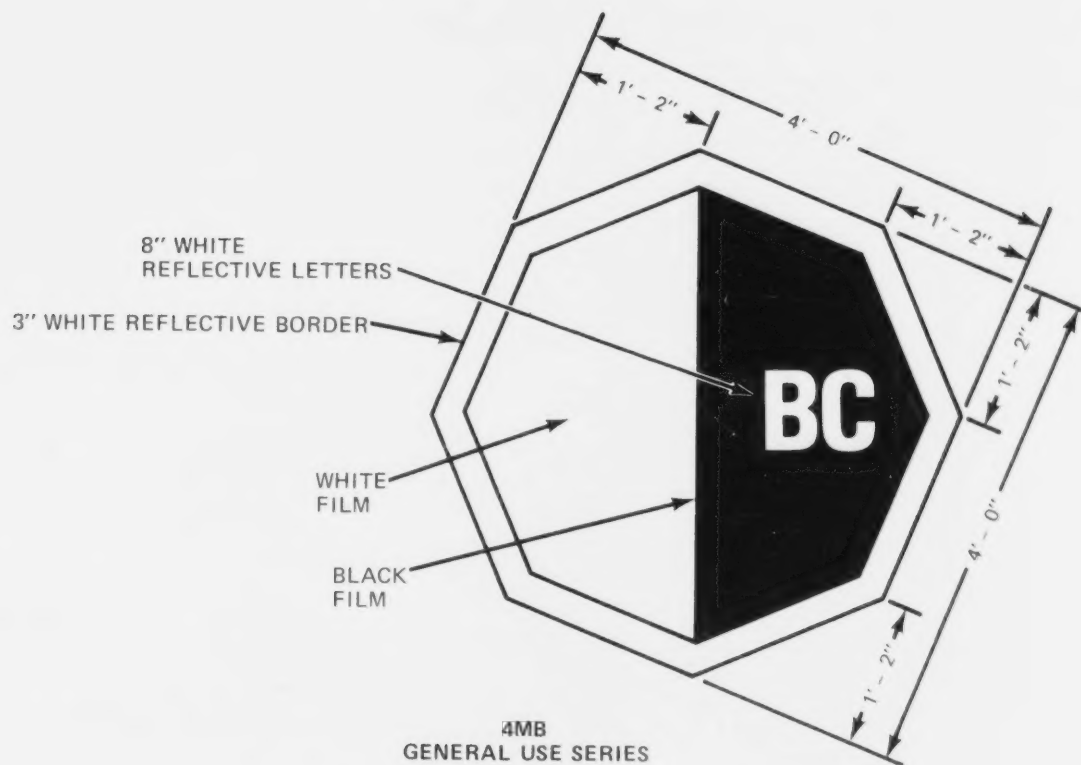


Figure 5-9. (cont'd).

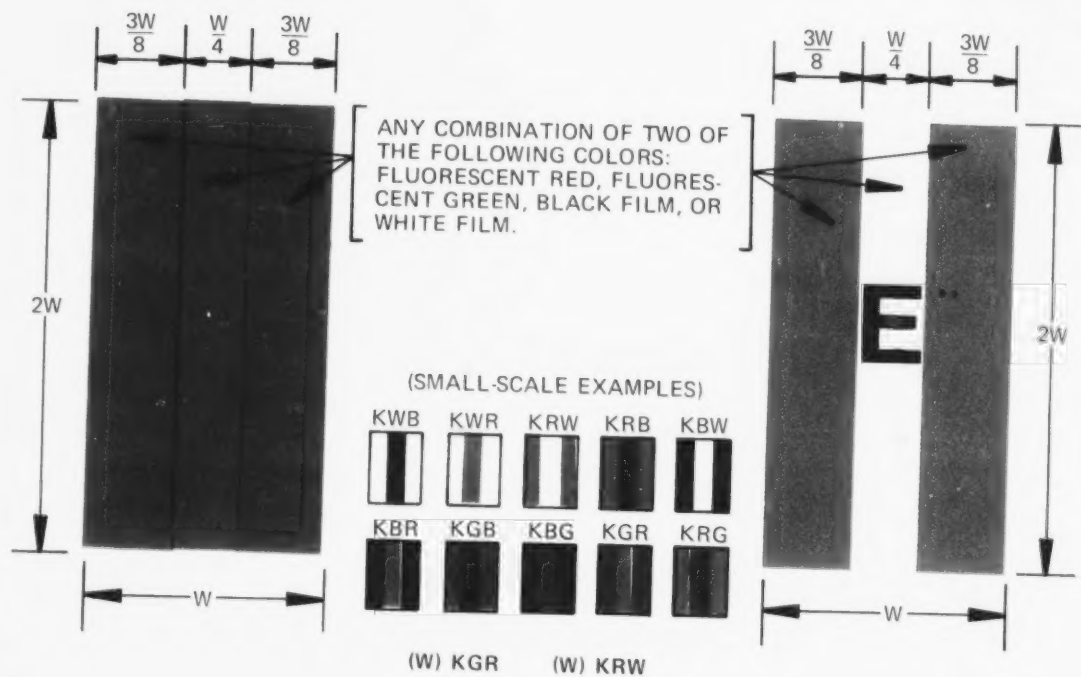
Data Sheet 5-D(5). (cont'd).

LATERAL GENERAL USE, OR LATERAL WESTERN RIVERS RANGE MARKERS

System: Lateral general use, or lateral western rivers

Function: Laterally significant range markers

Nominal Range: 1 to 5 nmi*



*See Table 5-4 for dimensions.

**Front range boards may be lettered with a contrasting colored (reflective or nonreflective) letter (white on black stripe, black on other stripes), sized according to channel requirements (see identification range of characters on Data Sheet 5-D(4)) and centered on the stripe halfway up the board.

Front and rear daymarks for a given range shall have the same major color as well as color of stripe.

Figure 5-10. Lateral general use, or lateral western rivers range markers.

Data Sheet 5-D(6). Lateral general use, or lateral western rivers range markers (nominal ranges, 1 to 5 nmi).

Table 5-4
Dimensions for 1- to 5-nmi Nominal Range Dayboards for
Lateral General Use, or Lateral Western Rivers Range Markers

<u>Nominal Range (nmi)</u>	<u>Width (W) (ft)</u>	<u>Major Color Panel Width, 3W/8 (in.)</u>	<u>Width of Stripe W/4 (in.)</u>
1	3	13.5	9
2	4	18	12
3	6	27	18
4	8	36	24
5	12	54	36

Data Sheet 5-D(6). (cont'd).

LATERAL INTRACOASTAL WATERWAY (ICW) PORT AND STARBOARD, JUNCTION, MID-CHANNEL, AND RANGE MARKERS

System: Lateral intracoastal waterway

Function: Laterally significant port and starboard, junction, mid-channel, and range markers

Nominal Range: All

Additional Data: ICW daymarks are identical to their general use counterparts (Data Sheets 5-D(1)--(6)) except for the yellow reflective ICW marking. For all sizes of daymarks, this marking consists of a 2-in., yellow reflective strip. On range daymarks, this strip is placed at the bottom of the front daymark only. The rear daymark of an ICW range shall not have the ICW marking. On other ICW daymarks, this strip is centered between the bottom of the reflective character and the reflective border.

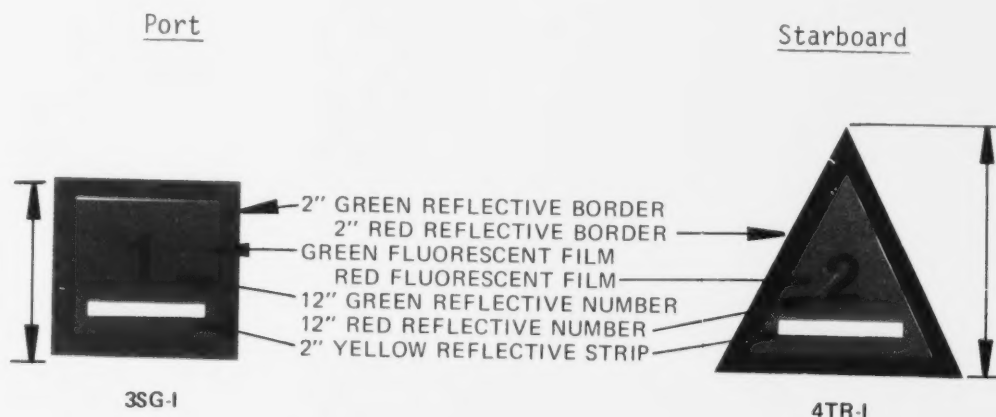


Figure 5-11. Lateral intracoastal waterway port and starboard markers.

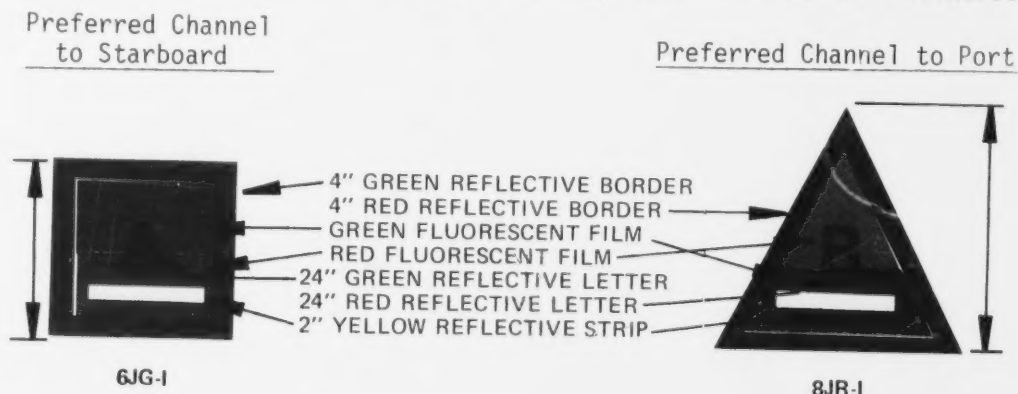


Figure 5-12. Lateral intracoastal waterway junction markers.

Data Sheet 5-D(7). Lateral intracoastal waterway (ICW) port and starboard, junction, mid-channel, and range markers.

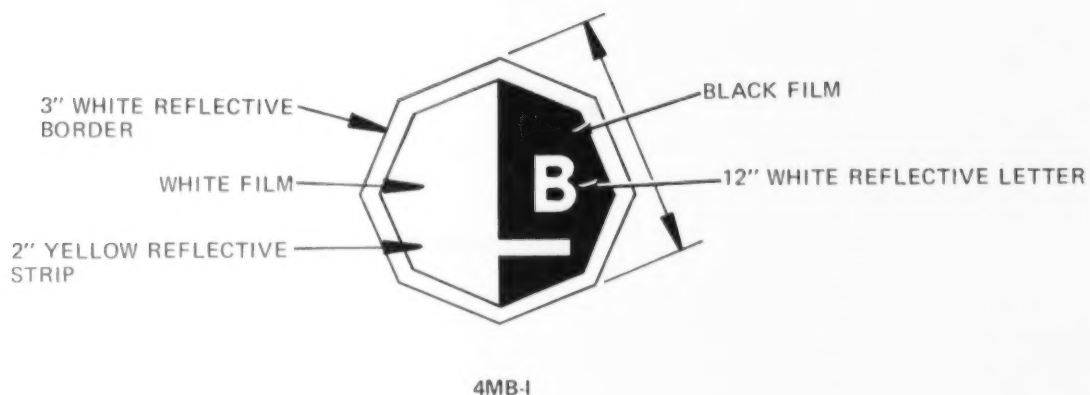


Figure 5-13. Lateral intracoastal waterway mid-channel marker.

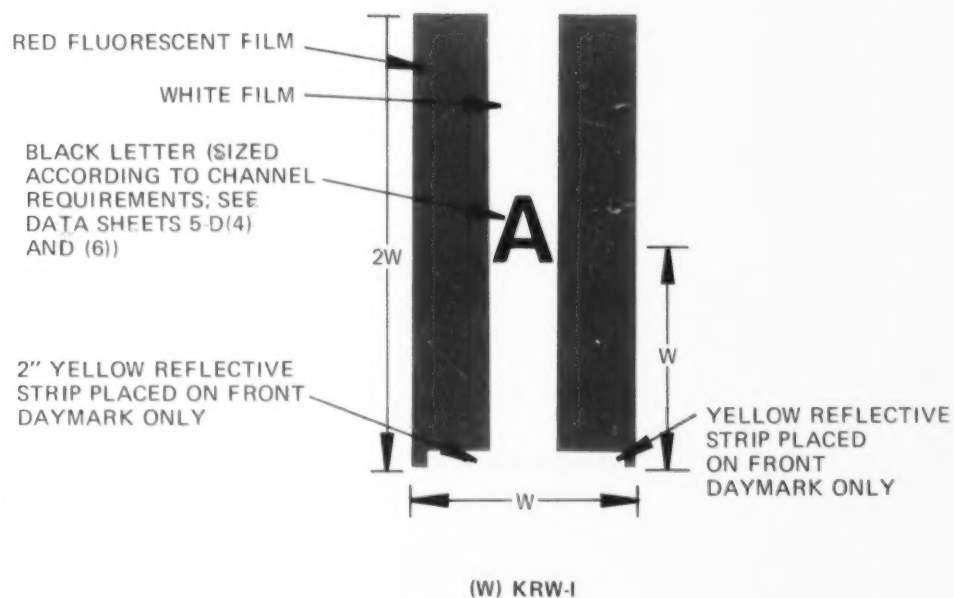


Figure 5-14. Lateral intracoastal waterway range marker.

Data Sheet 5-D(7). (cont'd)

LATERAL WESTERN RIVERS JUNCTION MARKERS

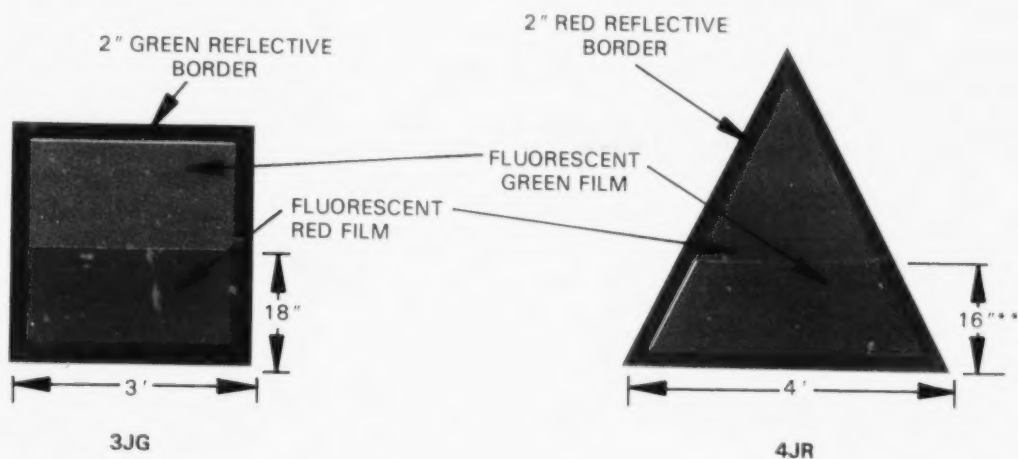
System: Lateral western rivers

Function: Laterally significant junction markers

Nominal Range: 1 nmi*

Preferred Channel
to Starboard

Preferred Channel
to Port



*For 2- and 3-nmi ranges, use the dimensions in Table 5-5.
**See Table 5-5, column 3.

Figure 5-15. Lateral western rivers junction markers.

Data Sheet 5-D(8). Lateral western rivers junction markers
(nominal ranges, 1, 2, and 3 nmi).

Table 5-5
Dimensions for 2- and 3-nmi Nominal Range Dayboards
for Lateral Western Rivers Junction Markers

<u>Nominal Range (nmi)</u>	<u>Width Square (ft)</u>	<u>Height of Dividing Line (in.)⁺</u>	<u>Border Width (in.)</u>	<u>1 Letter Size (in.)</u>	<u>2 Letter Size (in.)</u>
2	4		3	16	16
3	6		4	24	24
	<u>Width Triangle (ft)</u>				
2	6	24	3	16	12
3	8	32	4	24	16

⁺For triangular boards only; this is the height of the dividing line between fluorescent materials above the base.

LATERAL INTRACOASTAL WATERWAY (ICW) [IN CONJUNCTION WITH ANY OTHER WATERWAY]
DUAL PURPOSE PORT AND STARBOARD MARKERS

System: Lateral intracoastal waterway

Function: Laterally significant dual purpose port and starboard markers

Nominal Range: 1 nmi*

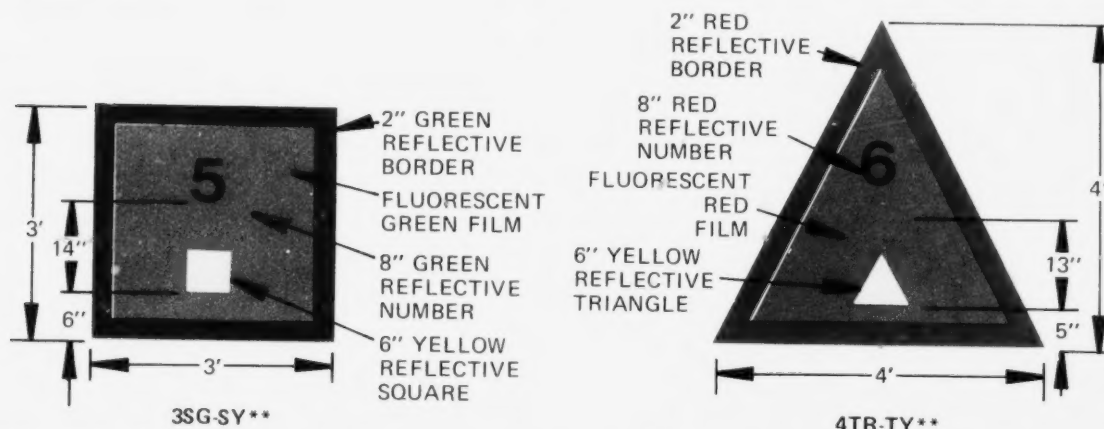


Figure 5-16(a). Lateral intracoastal waterway (in conjunction with any other waterway) dual purpose port and starboard markers--samples showing a situation where the lateral significance of the aid is the *same* for the ICW channel *and* the other channel.



*For 2- and 3-nmi ranges, use the dimensions in Table 5-6. Position markings shall have an appearance as shown.

**For two numerals, use 8-in. numbers, side by side; for three numerals, use 8-in. numbers on the square and on the *next larger size triangle*.

Figure 5-16(b). Lateral intracoastal waterway (in conjunction with any other waterway) dual purpose port and starboard markers--samples showing a situation where the lateral significance of the aid is the *opposite* for the ICW channel and the other channel.

Data Sheet 5-D(9). Lateral intracoastal waterway (ICW) [in conjunction with any other waterway] dual purpose port and starboard markers (nominal ranges, 1, 2, and 3 nmi).

Table 5-6
Dimensions for 2- and 3-nmi Nominal Range Dayboards for
Lateral Intracoastal Waterway (ICW)
[In Conjunction With Any Other Waterway]
Dual Purpose Port and Starboard Markers

<u>Nominal Range (nmi)</u>	<u>Width Square (ft)</u>	<u>Border Width (in.)</u>	<u>Yellow Square Width (in.)</u>	<u>1 Numeral Size (in.)</u>	<u>2 Numeral Size (in.)</u>	<u>3 Numeral Size (in.)</u>
2	4	3	9	12	12	12
3	6	4	12	16	16	16
	<u>Width Triangle (ft)</u>		<u>Yellow Triangle Width (in.)</u>			
2	6	3	9	12	8	8
3	8	4	12	16	12	12

Data Sheet 5-D(9). (cont'd).

LATERAL INTRACOASTAL WATERWAY (ICW) [IN CONJUNCTION WITH ANY OTHER WATERWAY]
DUAL PURPOSE JUNCTION MARKERS

System: Lateral intracoastal waterway

Function: Laterally significant dual purpose junction markers

Nominal Range: 1 nmi*

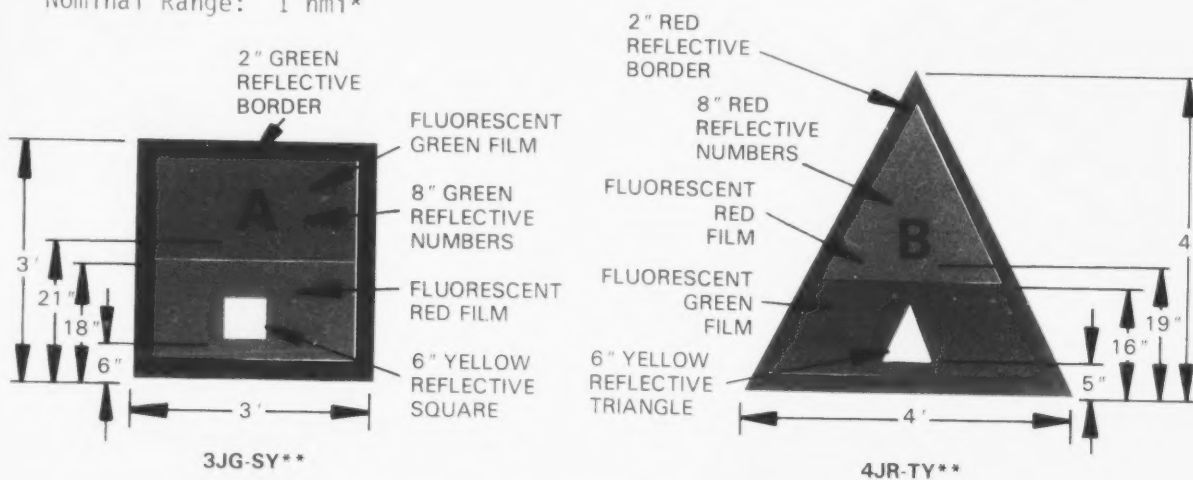


Figure 5-17(a). Lateral intracoastal waterway (in conjunction with any other waterway) dual purpose junction markers--samples showing a situation where the lateral significance of the aid is the same for the ICW channel and the other channel.



*For 2- and 3-nmi ranges, use the dimensions in Table 5-7. Position markings shall have an appearance as shown.

**For two letters, use 8-in. letters, side by side.

Figure 5-17(b). Lateral intracoastal waterway (in conjunction with any other waterway) dual purpose junction markers--samples showing a situation where the lateral significance of the aid is the opposite for the ICW channel and the other channel.

Data Sheet 5-D(10). Lateral intracoastal waterway (ICW) [in conjunction with any other waterway] dual purpose junction markers (nominal ranges, 1, 2, and 3 nmi).

Table 5-7
Dimensions for 2- and 3-nmi Nominal Range Dayboards for
Lateral Intracoastal Waterway (ICW)
[In Conjunction With Any Other Waterway]
Dual Purpose Junction Markers

<u>Nominal Range (nmi)</u>	<u>Width Square (ft)</u>	<u>Border Width (in.)</u>	<u>Yellow Square Width (in.)</u>	<u>1 Letter Size (in.)</u>	<u>2 Letter Size (in.)</u>
2	4	3	9	12	12
3	6	4	12	16	16
	<u>Width Triangle (ft)</u>		<u>Yellow Triangle Width (in.)</u>		
2	6	3	9	12	8
3	8	4	12	16	12

Data Sheet 5-D(10). (cont'd).

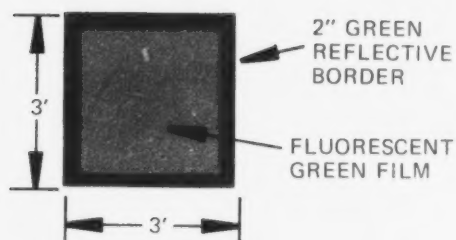
LATERAL WESTERN RIVERS PASSING, CROSSING, AND DISTANCE MARKERS

System: Lateral western rivers

Function: Laterally significant passing and crossing markers and no lateral significance distance markers

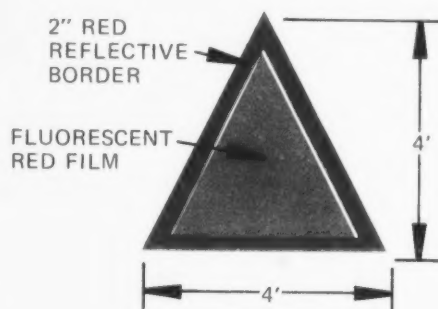
Nominal Range: 1 nmi*

Port Side Marker



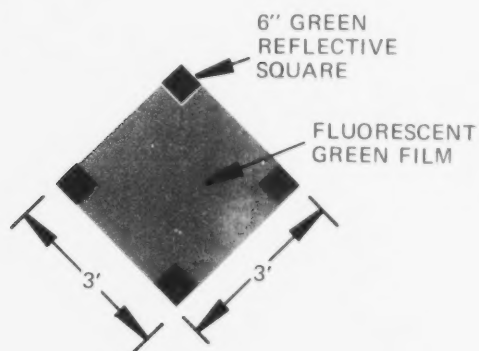
3SG

Starboard Side Marker

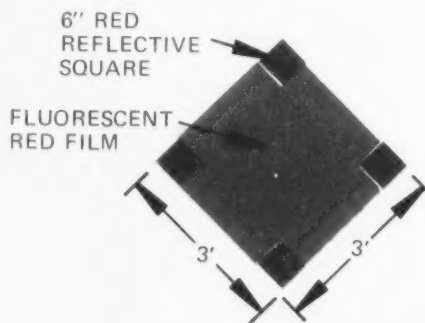


4TR

Figure 5-18. Lateral western rivers passing markers (nominal ranges, 1, 2, and 3 nmi).



3CG



3CR

Figure 5-19. Lateral western rivers crossing markers (nominal ranges, 1, 2, and 3 nmi).

*For 2- and 3-nmi ranges, use the dimensions in Table 5-8.

Data Sheet 5-D(11). Lateral western rivers passing, crossing, and distance markers (nominal ranges, 1, 2, and 3 nmi).

Table 5-8
Dimensions for 2- and 3-nmi Nominal Range Dayboards for
Lateral Western Rivers Passing and Crossing Markers

Nominal Range (nmi)	Designation	Border Width (in.)	Corner Square Width (in.)
2	4SG, 6TR	3	none
2	4CG, 4CR	none	9
3	6SG, 8TR	4	none
3	6CG, 6CG	none	12

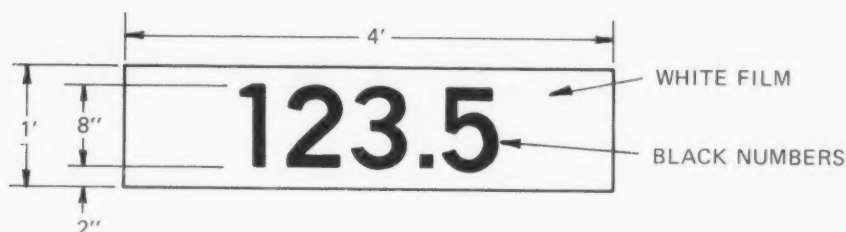


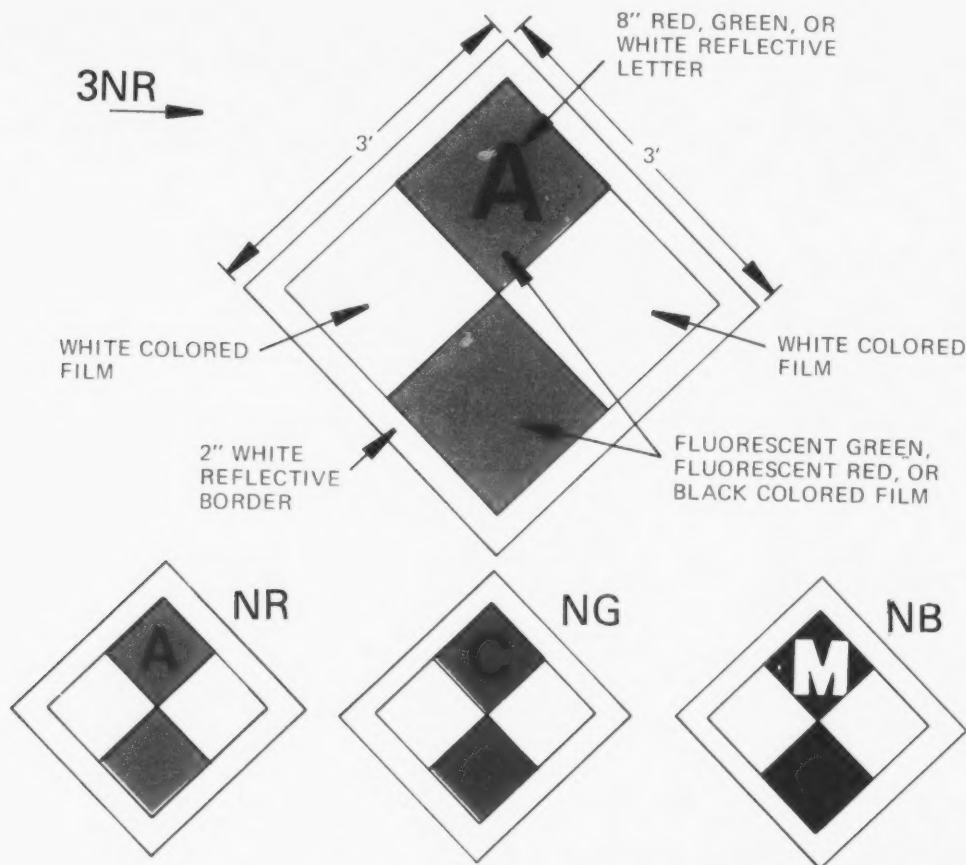
Figure 5-20. Lateral western rivers distance marker (displayed 6 in. below passing or crossing markers; the 1- by 4-ft distance marker is used with all sizes of dayboards).

ALL WATERWAYS SPECIAL PURPOSE MARKERS

System: All waterways

Function: No lateral significance special purpose markers

Nominal Range: 1 nmi*



*Use the dimensions in Table 5-9 for 2- and 3-nmi ranges.

**Red letters shall be used on red colored film, green letters on green colored film, and white letters on black colored film. General-use markers can be used in the intracoastal waterway, but no yellow strip is used.

Figure 5-21. All waterways special purpose markers.

Data Sheet 5-D(12). All waterways special purpose markers (nominal ranges, 1, 2, and 3 nmi).

Table 5-9
Dimensions for 2- and 3-nmi Nominal Range Dayboards for
All Waterways Special Purpose Markers

<u>Nominal Range (nmi)</u>	<u>Size Dayboard (ft)</u>	<u>Border Width (in.)</u>	<u>Letter Size (in.)</u>
2	4	3	12
3	6	4	16

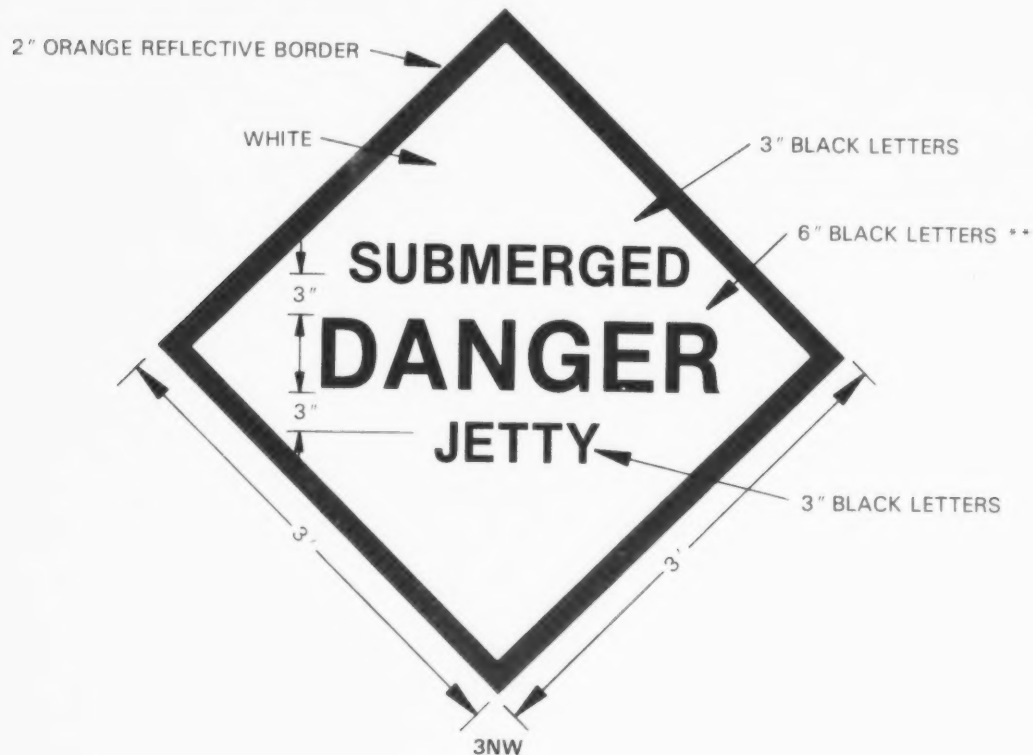
Data Sheet 5-D(12). (cont'd).

ALL WATERWAYS WARNING MARKERS

System: All waterways

Function: No lateral significance warning markers

Nominal Range: 1 nmi*



*Use the dimensions in Table 5-10 for 2- and 3-nmi ranges.

**The word "DANGER" is to be placed on all warning daymarks. Informational words may be placed below, or above and below, to suit particular needs. Examples:

DANGER
ROCK

MARINE
DANGER
CONSTRUCTION

Figure 5-22. All waterways warning marker.

Data Sheet 5-D(13). All waterways warning markers (nominal ranges, 1, 2, and 3 nmi).

Table 5-10
Dimensions for 2- and 3-nmi Nominal Range Dayboards for
All Waterways Warning Markers

<u>Nominal Range (nmi)</u>	<u>Size Dayboard (ft)</u>	<u>Border Width (in.)</u>	<u>DANGER Letter Size (in.)</u>	<u>Other Letter Size (in.)</u>
2	4	3	8	4
3	6	4	10	5

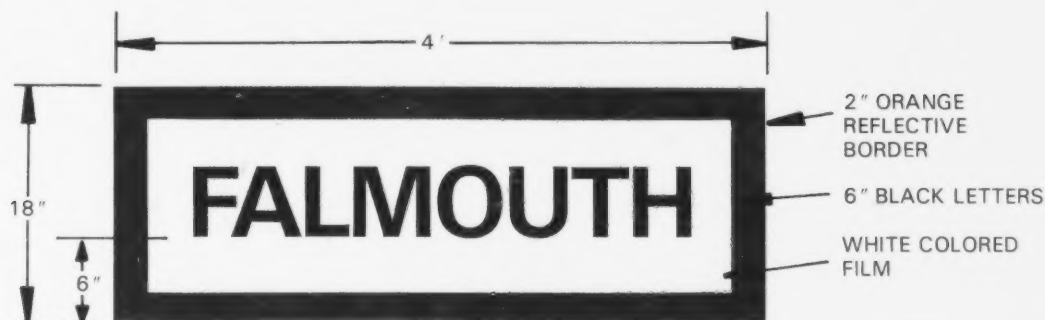
Data Sheet 5-D(13). (cont'd).

ALL WATERWAYS LOCATION MARKERS

System: All waterways

Function: No lateral significance location markers*

Nominal Range: 1 nmi**



*Location markers are used on structures to indicate the approach or entrance to a harbor.

**For 2- and 3-nmi ranges, use the dimensions in Table 5-11.

Figure 5-23. All waterways location marker (to be placed on the structure directly below the existing daymark).

Table 5-11

Dimensions for 2- and 3-nmi Nominal Range Dayboards for All Waterways Location Markers

Nominal Range (nmi)	Length (ft)	Width (in.)	Border Width (in.)	Letter Size (in.)
2	6	24	3	8 (maximum)
3	8	30	4	10 (maximum)

Data Sheet 5-D(14). All waterways location markers (nominal ranges, 1, 2, and 3 nmi).

LATERAL INTRACOASTAL WATERWAY (ICW) DISTANCE MARKERS

System: Lateral intracoastal waterway

Function: No lateral significance distance markers

Nominal Range: 1/2 nmi

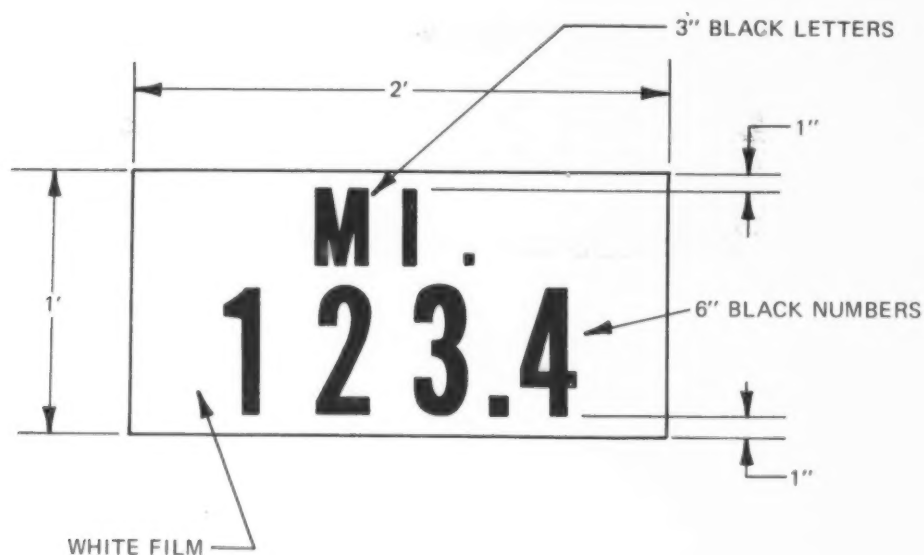


Figure 5-24. Lateral intracoastal waterway distance marker.

Data Sheet 5-D(15). Lateral intracoastal waterway (ICW) distance markers (nominal range, 1/2 nmi).

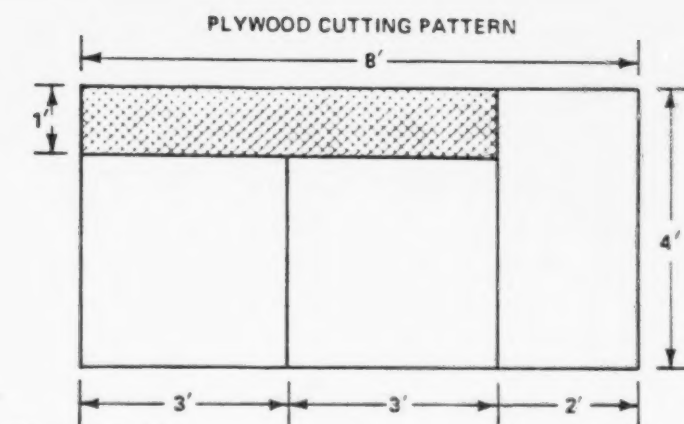
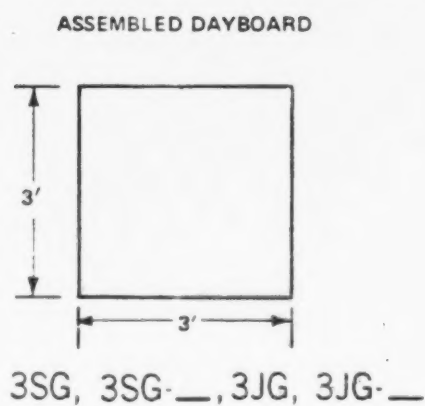
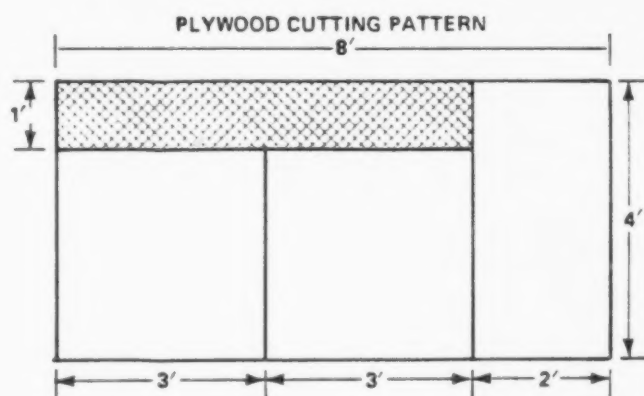
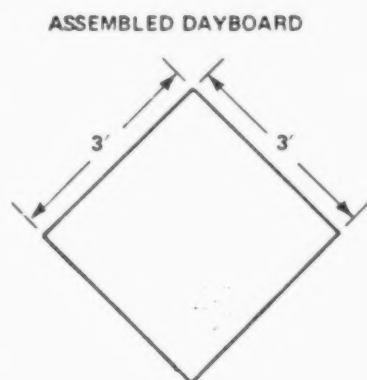


Figure 5-25



3CG, 3CR, 3NB, 3NG, 3NR, 3NW, 3NY Figure 5-26



= BACKING OR MILE BOARD MATERIAL

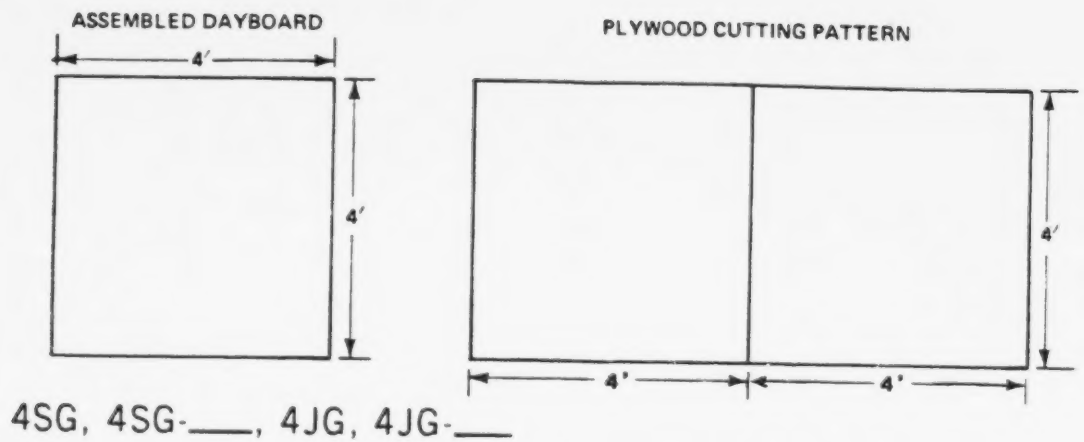


Figure 5-27

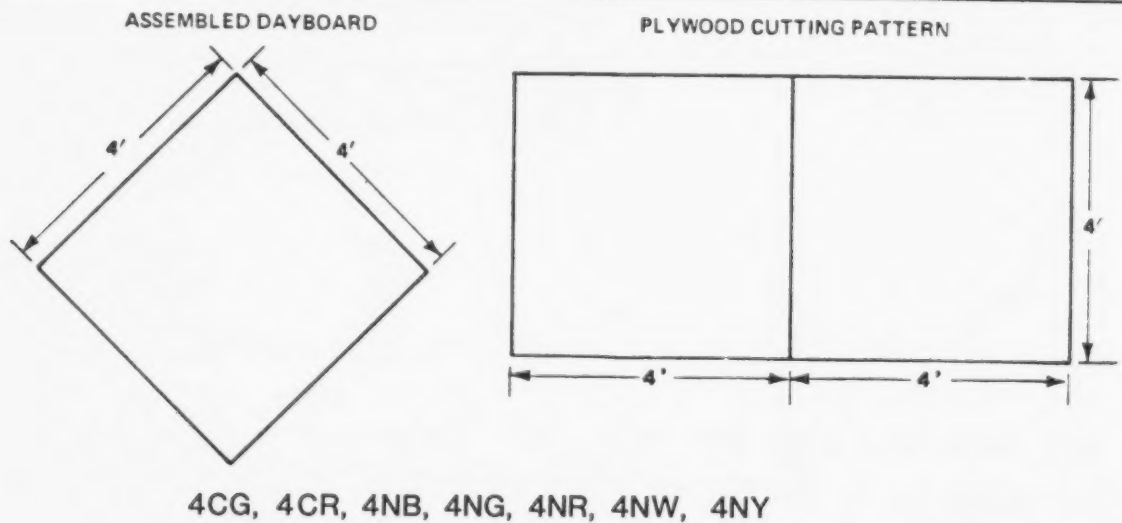
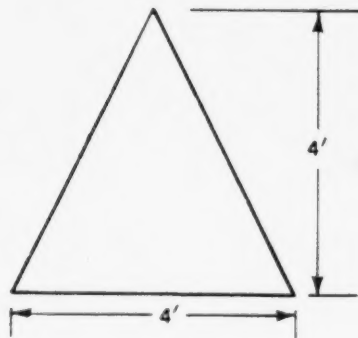


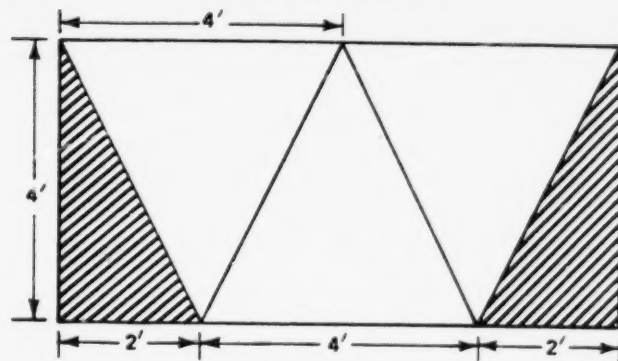
Figure 5-28

NOTE: DASHED LINES INDICATE HOW DAYBOARD IS TO BE ASSEMBLED FROM CUT PLYWOOD PIECES.

ASSEMBLED DAYBOARD



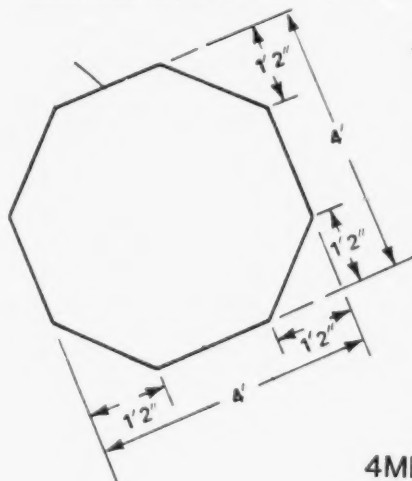
PLYWOOD CUTTING PATTERN



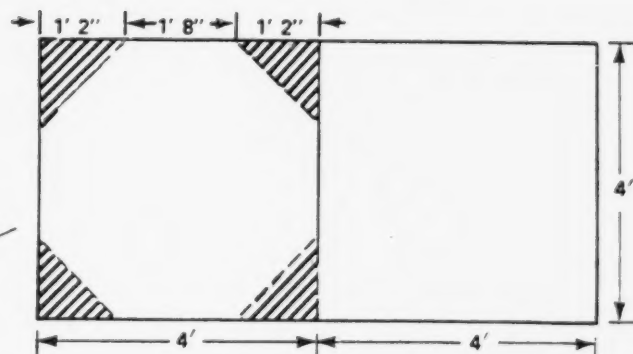
4TR, 4TR-___, 4JR, 4JR-___

Figure 5-29

ASSEMBLED DAYBOARD



PLYWOOD CUTTING PATTERN



4MB, 4MR

Figure 5-30



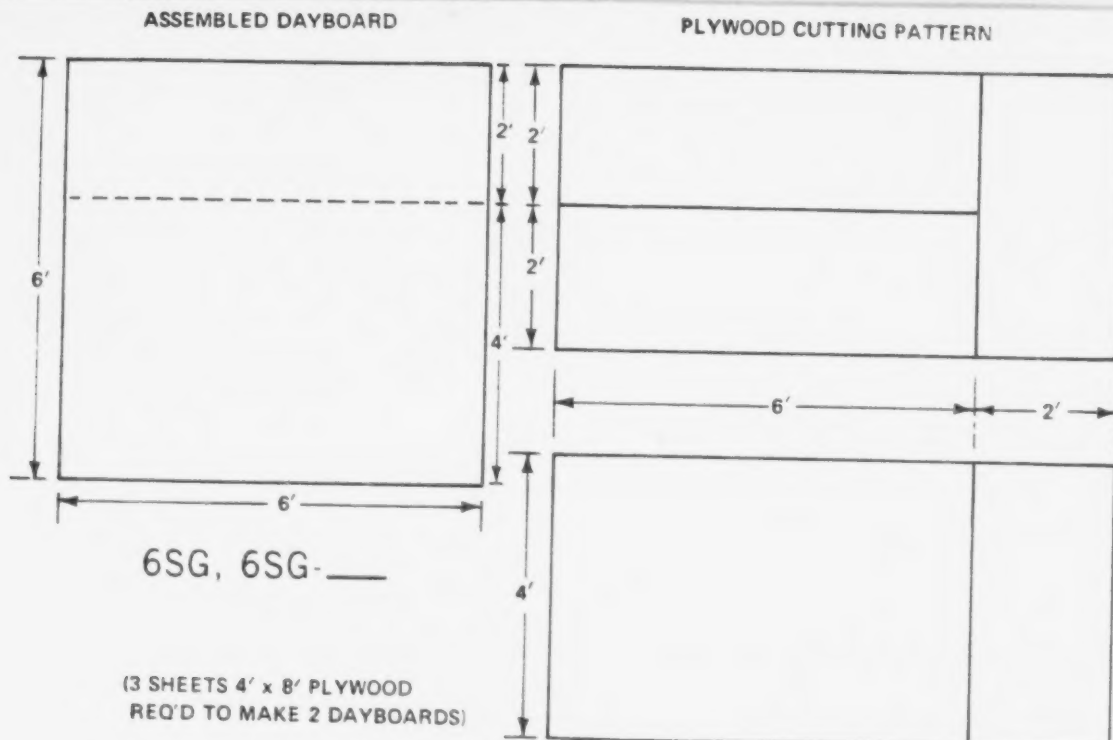


Figure 5-31

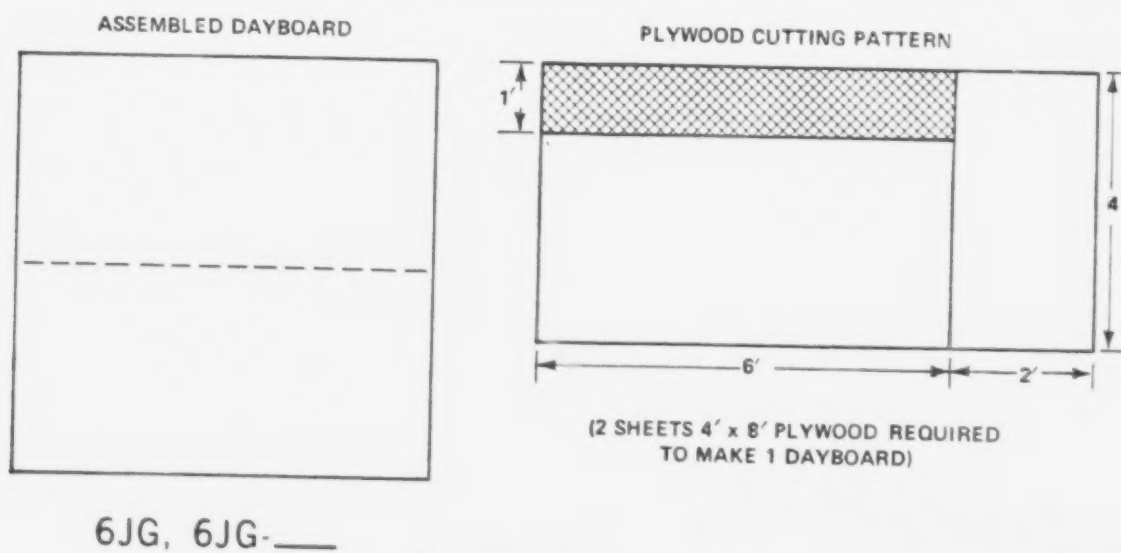


Figure 5-32



= BACKING OR MILE BOARD MATERIAL

NOTE: DASHED LINES INDICATE HOW DAYBOARD IS TO BE ASSEMBLED FROM CUT PLYWOOD PIECES.

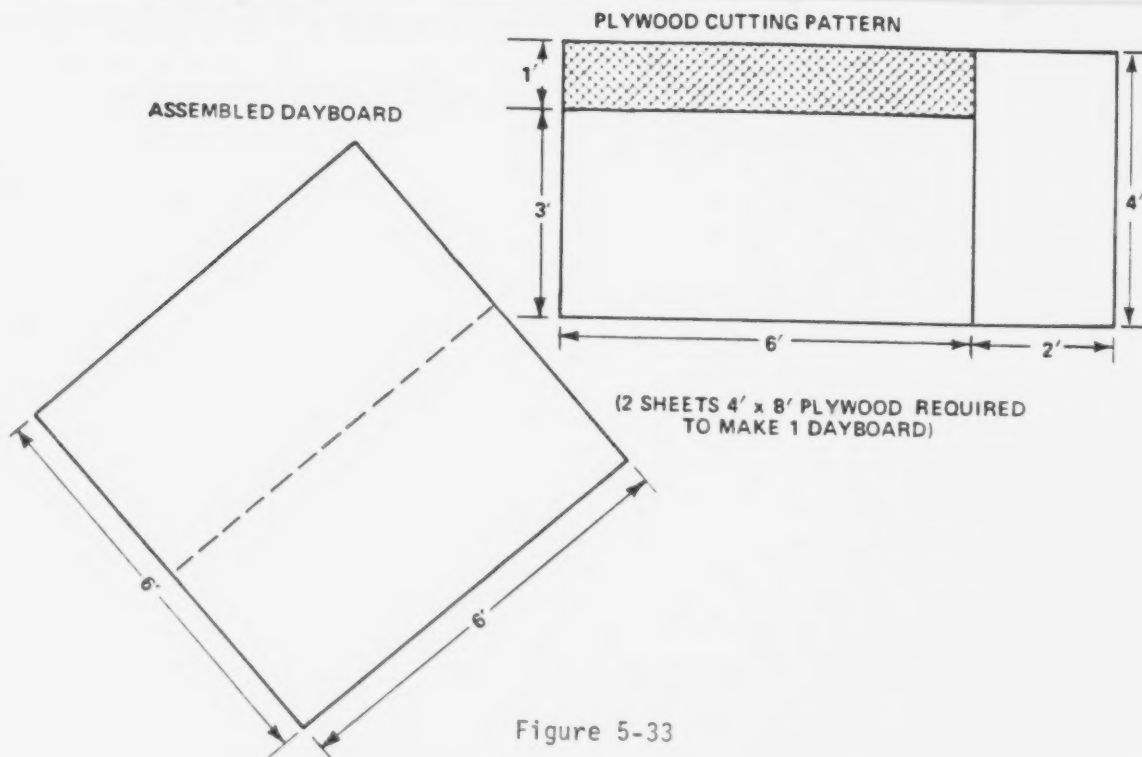


Figure 5-33

6CR, 6CG, 6NB, 6NG, 6NR, 6NW, 6NY

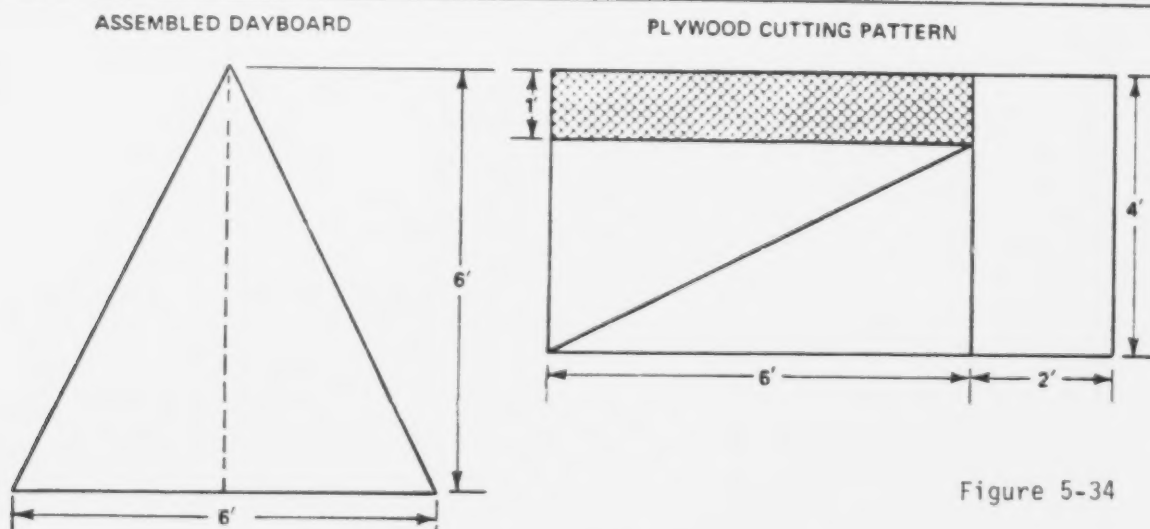


Figure 5-34

6TR, 6TR-___, 6JR, 6JR-___

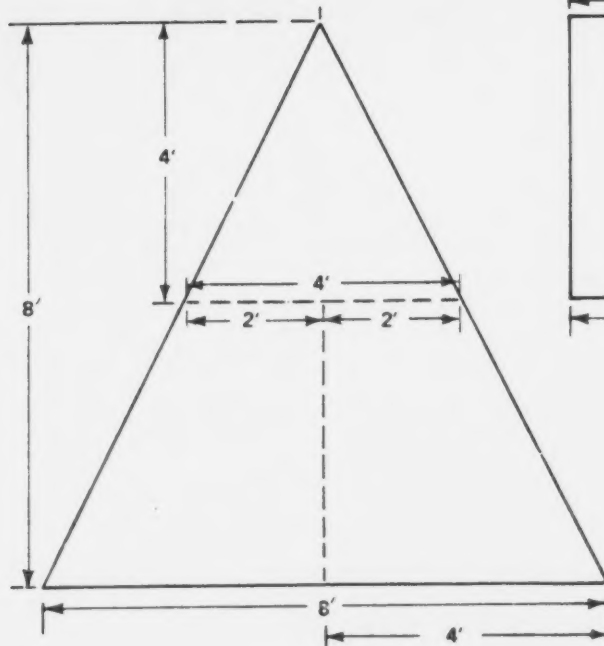


= BACKING OR MILE BOARD MATERIAL

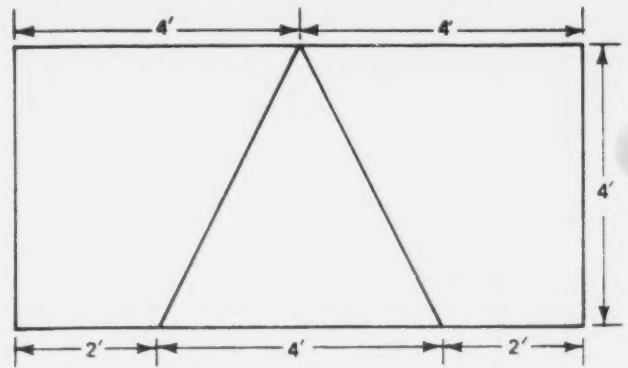
NOTE: DASHED LINES INDICATE HOW DAYBOARD IS TO BE ASSEMBLED FROM CUT PLYWOOD PIECES.

Data Sheet 5-D(16). (cont'd).

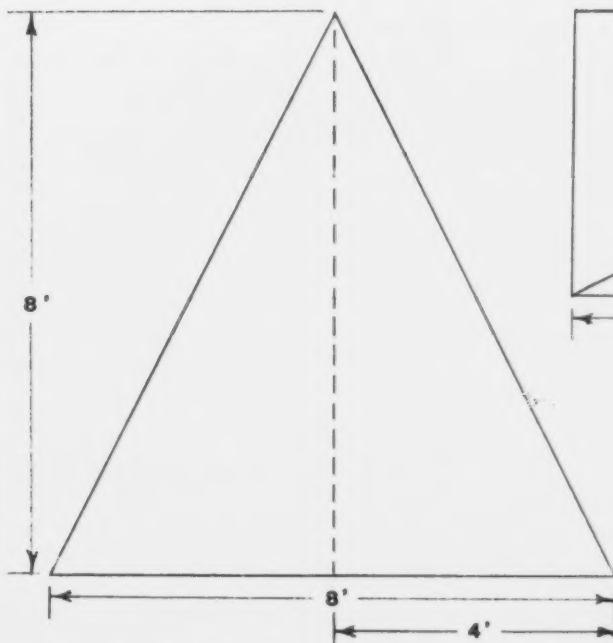
ASSEMBLED DAYBOARD



PLYWOOD CUTTING PATTERN



ASSEMBLED DAYBOARD



ALTERNATE PLYWOOD CUTTING PATTERN

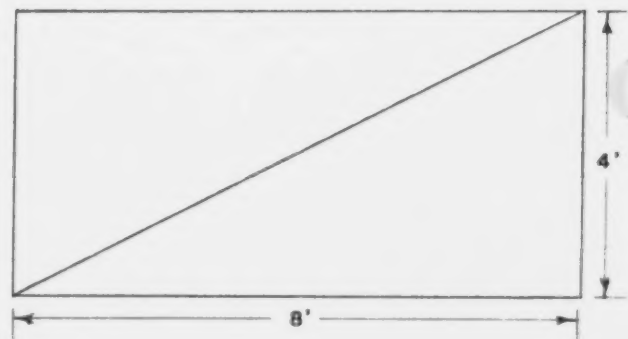
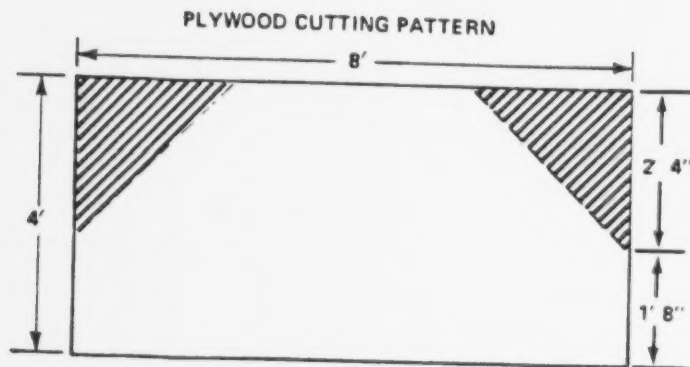


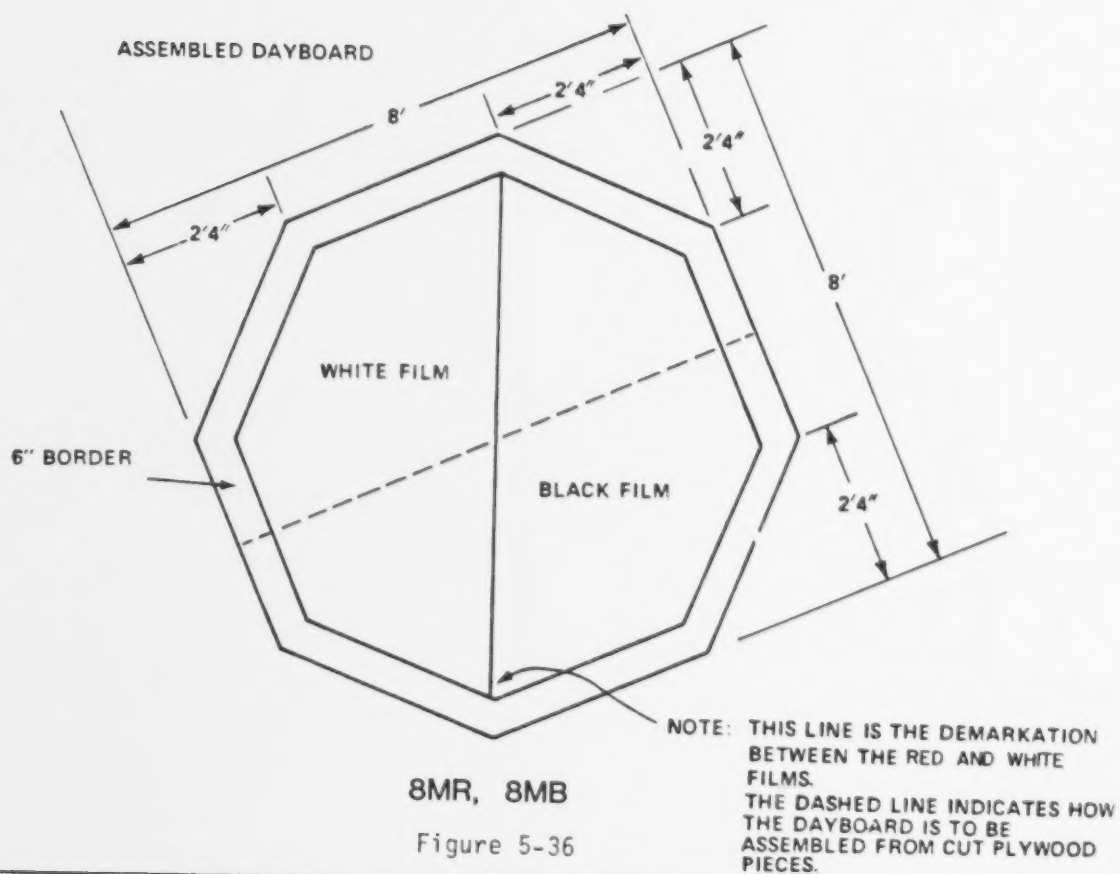
Figure 5-35

8TR, 8TR-____, 8JR, 8JR-____

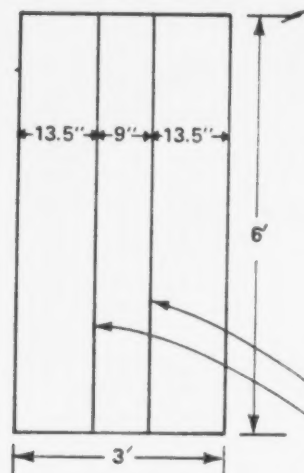
NOTE: Dashed line indicates how dayboard is to be assembled from cut plywood pieces.



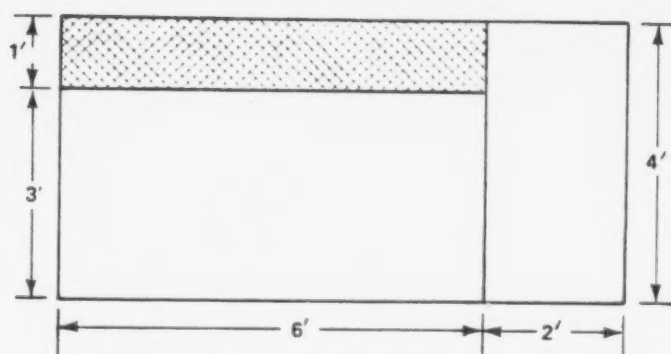
(2 SHEETS 4 x 8 PLYWOOD REQUIRED
TO MAKE 1 DAYBOARD)



ASSEMBLED DAYBOARD



PLYWOOD CUTTING PATTERN



THESE LINES DENOTE THE COLOR PATTERN OF THE FLUORESCENT FILMS.

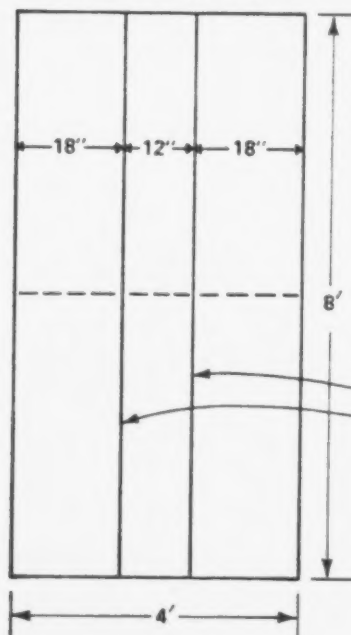
3K — —



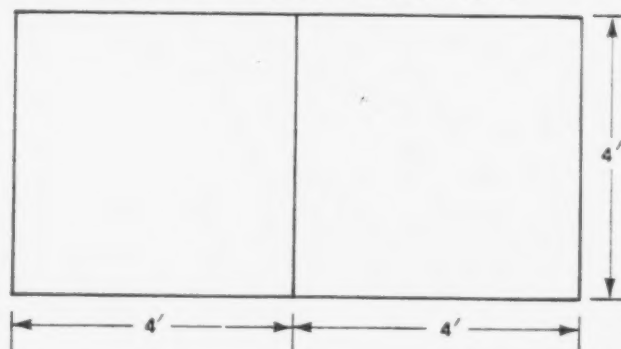
= BACKING OR MILE BOARD MATERIAL

Figure 5-37

ASSEMBLED DAYBOARD



OPTIONAL PLYWOOD CUTTING PATTERN

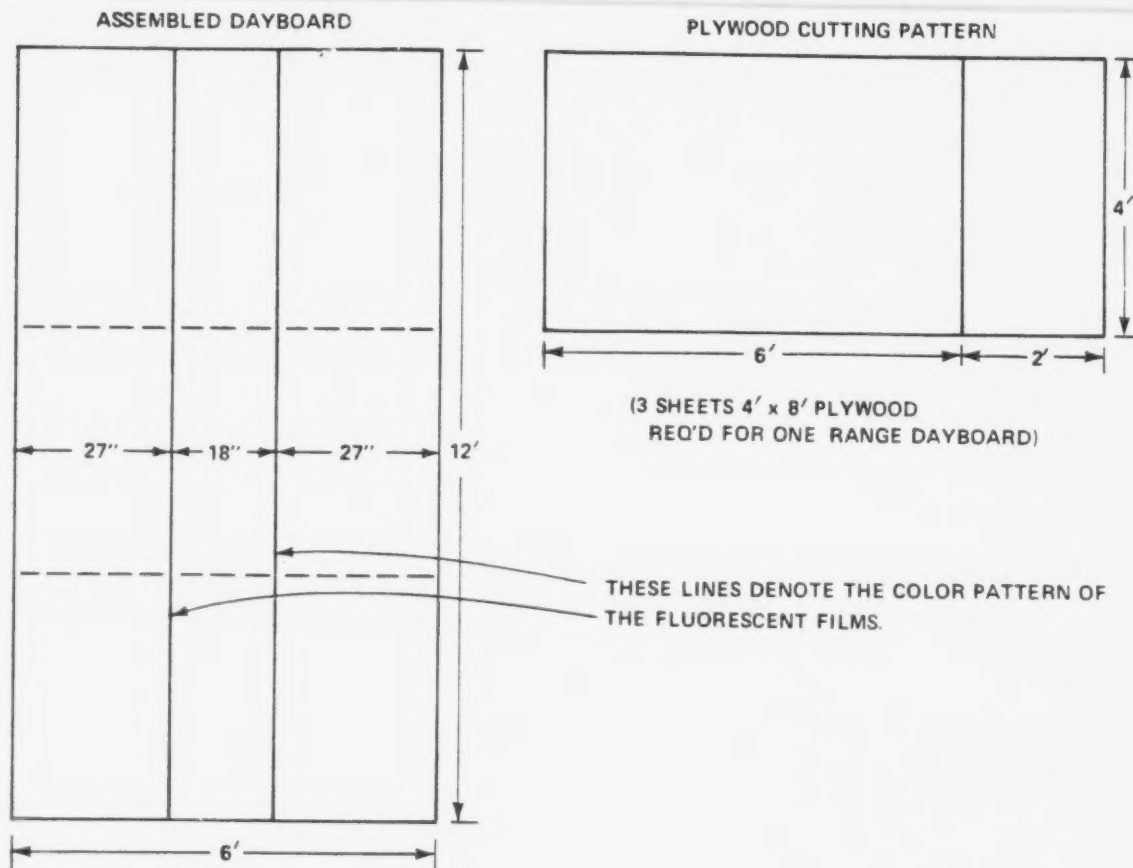


THESE LINES DENOTE THE COLOR PATTERN OF THE FLUORESCENT FILMS.

NOTE: 4 x 8 PLYWOOD SHEET NEED NOT BE CUT IF PRESSURE SENSITIVE SCOTCHCAL IS USED EXCEPT TO FACILITATE STORAGE, SHIPPING, AND HANDLING. THE DASHED LINE INDICATES HOW DAYBOARD IS TO BE ASSEMBLED FROM CUT PLYWOOD PIECES.

4K — —

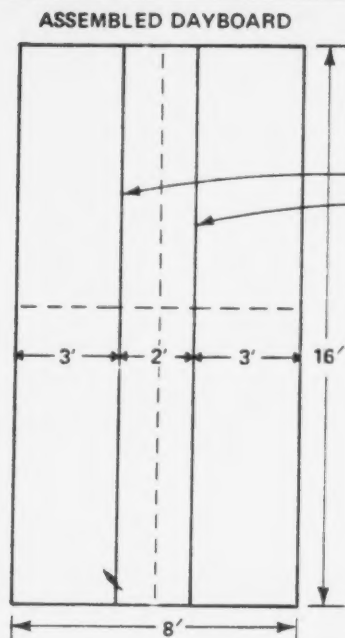
Figure 5-38



6K _ _

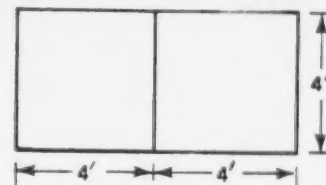
Figure 5-39

NOTE: DASHED LINES INDICATE HOW DAYBOARD IS TO BE
ASSEMBLED FROM CUT PLYWOOD PIECES.



THESE LINES DENOTE THE
COLOR PATTERN OF
THE FLUORESCENT FILMS.

OPTIONAL PLYWOOD CUTTING PATTERN

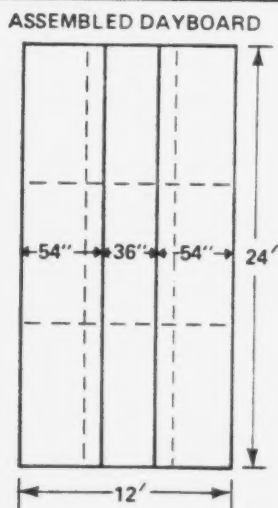


NOTE: 4' x 8' PLYWOOD SHEETS NEED NOT BE CUT
IF PRESSURE SENSITIVE SCOTCHCAL IS USED,
EXCEPT TO FACILITATE STORAGE, SHIPPING,
AND HANDLING.

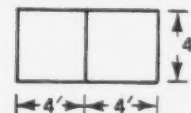
(4 SHEETS 4 x 8 PLYWOOD REQUIRED
FOR ONE RANGE DAYBOARD)

*8K _ _

Figure 5-40



OPTIONAL PLYWOOD CUTTING PATTERN



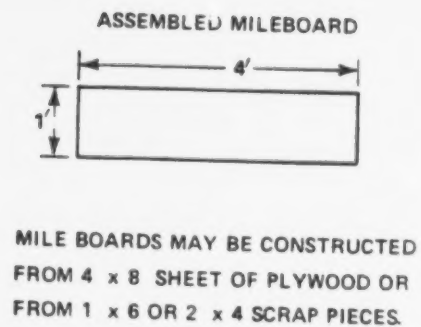
NOTE: 4' x 8' PLYWOOD SHEETS NEED NOT BE CUT
IF PRESSURE SENSITIVE SCOTCHCAL IS USED,
EXCEPT TO FACILITATE STORAGE, SHIPPING,
AND HANDLING.

(9 SHEETS 4' x 8' PLYWOOD REQUIRED
FOR ONE RANGE DAYBOARD)

*12 K _ _

Figure 5-41

*NOTE: Partitioning for larger size range dayboards should be specified for the particular application.
DASHED LINES INDICATE HOW DAYBOARD MAY POSSIBLY BE ASSEMBLED FROM
THE 4' x 8' PLYWOOD SHEETS, IF PLYWOOD IS NOT CUT.



MILE BOARDS

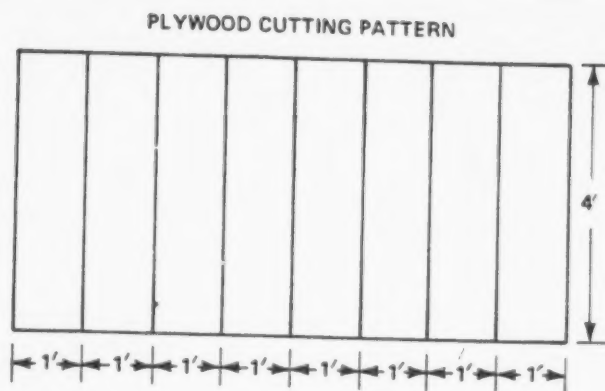
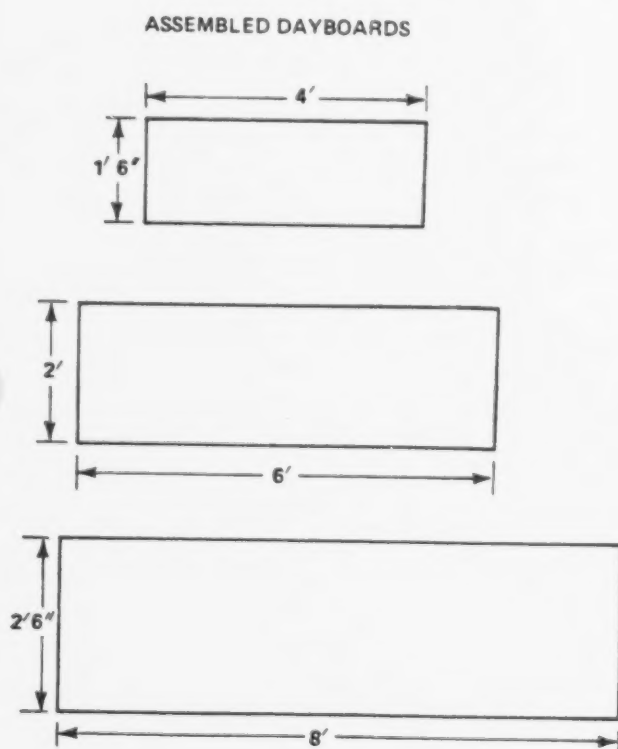


Figure 5-42



LOCATION DAYBOARDS

OPTIONAL PLYWOOD CUTTING PATTERNS

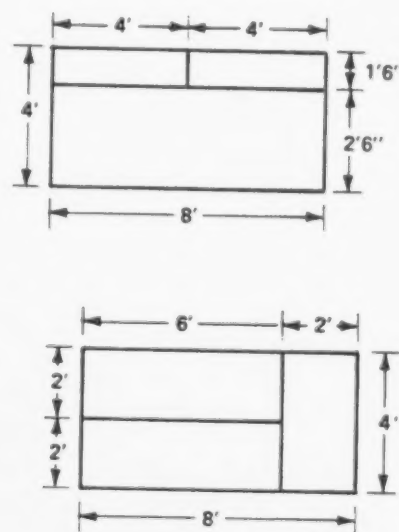


Figure 5-43

CHAPTER 6 LIGHT SIGNALS

This chapter describes the components of standard aids to navigation light signals--the housing, lenses, lamps, lampchangers, flashers, brackets, daylight controls, and wiring. A selection guide, which matches the available types of lighted aids to the required nominal range, is provided for use when establishing new lights or replacing

obsolete equipment. In another section, routine maintenance and the criteria for focusing, leveling, and azimuth alignment (when necessary) are outlined for each type of lighted aid. Additional information about the equipment can be found in the manufacturers' manuals, the CG-250 reports, and Coast Guard Research and Development Reports.

A. SELECTION GUIDE

Tables 6-1 through 6-3 can be used to select standard lighted aids to navigation signaling equipment to meet a specific application. Table 6-1 should be consulted when an omnidirectional light and a 12 V power source will be used--either battery or ac-dc converter. Table 6-2 is applicable for omnidirectional aids that use 120 Vac power. Table 6-3 is a decision-making tool for use when directional light beams are required. Tables 6-4 through 6-6 can be used to select standard lighted aids to navigation signaling equipment for use as range lights only.

Nominal range and color must be known before using the tables, which are

designed to provide available hardware and characteristic combinations.

Nominal ranges listed in tables 6-1 through 6-3 are based on a transmissivity of 0.74, with a practical threshold of 0.67 sea-mile candela, and are listed for standard optics, lamps, and characteristics only. Nominal ranges listed in the tables 6-4 and 6-5 are based on a transmissivity of 0.74 with a practical threshold of 3.35 sea-mile candela. For specific applications that require special characteristics or higher thresholds, refer to Luminous Intensities of Aids to Navigation Lights, COMDTINST M16510.2.

Note: The selection guide is only a guide. The assumptions for each table must be understood before an optic is selected for a particular application. Refer any question on the use of either the selection guide or COMDTINST M16510.2 to G-EOE-4A FTS 426-1102.

Selection Guide for Omnidirectional Lanterns Using 12 Vdc Lamps
(lamps rated in amperes)

Type C for clear lenses and covers
Type R for colored lenses and covers

F1. -showing a single flash at regular intervals, the duration of light always being less than the duration of darkness.

Go. F1. -showing at regular intervals groups of two or more flashes.

Example: Enter table with the nominal range and color required for the given application. The horizontal row gives the standard size 12 V lamp (in amperes) for use with the Co-181 characteristic heading in each vertical column. Note that the available characteristics are listed for each of the standard optics of the 12 V lamp. Only the 156-mm lantern is authorized for buoys and those structures most likely to be tilted or damaged as a result of collision or natural forces. When more than one optic/lamp combination is available for the desired range or color, refer to the listing for the selection based on life-time cost.

In each case, the CG-6P lampchanger is used in conjunction with CG-181

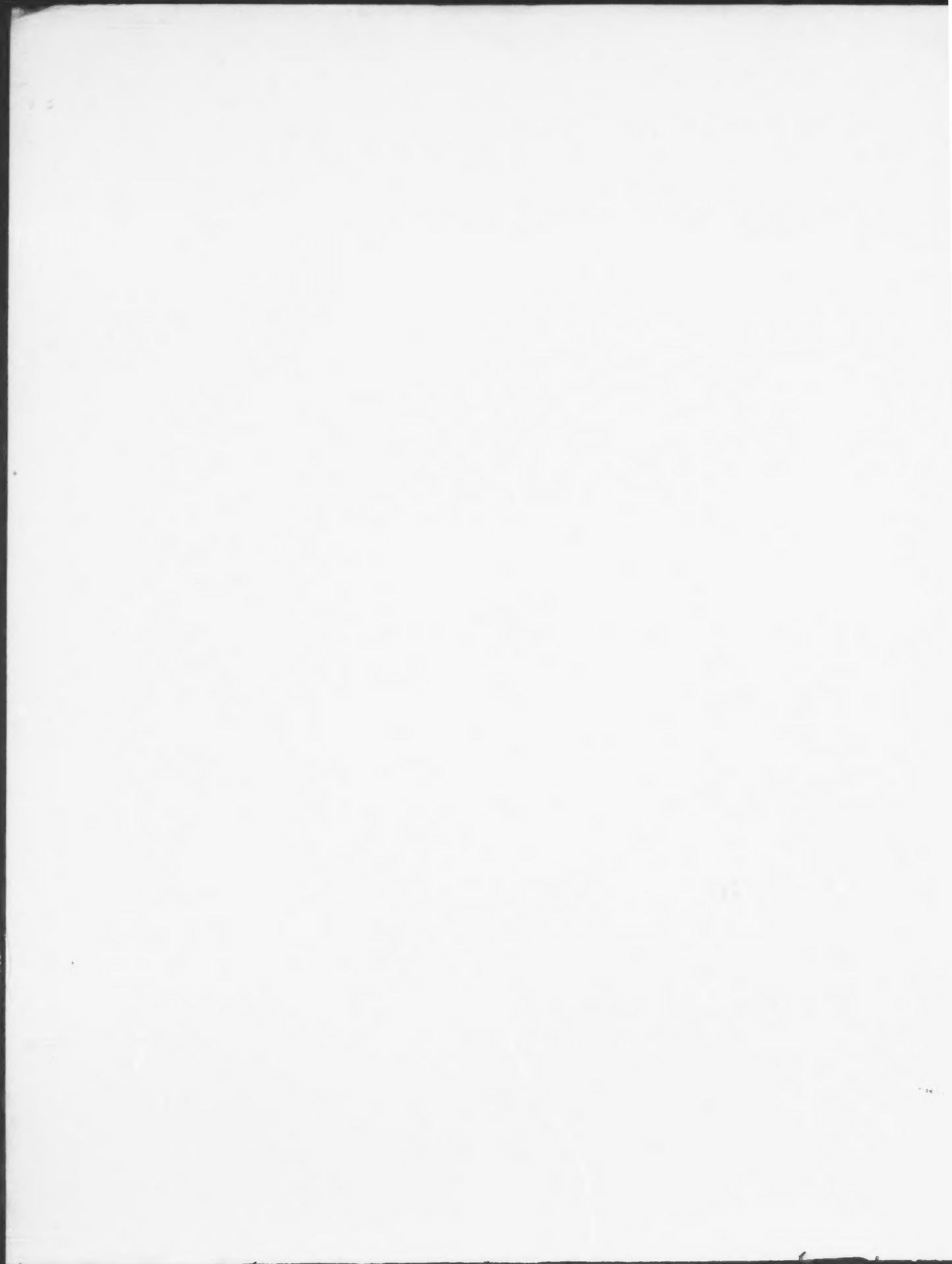


TABLE 6--2
SELECTION GUIDE FOR OMNIDIRECTIONAL LANTERNS USING 120 VAC LAMPS
(LAMPS RATED IN WATTS)

OPTIC	DCB-24, rpm (FL)										FA261-AC, rpm (FI)					300 mm FL length (sec)					250 mm FL length (sec)				
	1 (.31)	2 (.20)	3 (.15)	4 (.12)	5 (.10)	6 (.08)	10 (.05)	12 (.04)	15 (.03)	1	2 (.10)	4 (.06)	5 (.05)	10 (.03)	.3	.4	.5	1	3	FIX	.3	.4	.5	1	3
CHARACTERISTIC																									
NORMAL RANGE (mm)																									
RED OR GREEN																									
CLEAR																									
7																									
8																									
9																									
10																									
11																									
12																									
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26																									

NOTE: ENTER TABLE WITH THE NOMINAL RANGE AND COLOR REQUIRED FOR THE GIVEN APPLICATION. THE HORIZONTAL ROW GIVES THE SIZE 120 V LAMP (IN WATTS) FOR USE WITH THE FLASH LENGTH OR RPM HEADING EACH VERTICAL COLUMN AND THE APPROPRIATE OPTIC. THE CG-GCF-RWL 2108 AC FLASH CONTROLLER IS USED WITH THE 250- AND 300-MM LANTERNS. THE CG-GCF-RWL 2088 AND VISUAL SENSOR CAN BE USED WITH ALL OF THE ABOVE SYSTEMS. NOTE THE FOLLOWING MAXIMUM DUTY CYCLE FOR THE 250W LAMP IN THE 250MM LANTERN IS 32% AND IN THE VENTED 250MM LANTERN IS 80%.



- * Lightning protected
- * Can be synchronized by a land line
- * Provisions for daylight control

Electrical and Mechanical Characteristics

Input voltage	120 volts AC, 50-60 Hz
Output voltage	120 volts AC
Maximum load	250 watts
Ambient temperature range	-30C to +55C
Timing tolerance	+6%
Height	117mm
Diameter	100mm
Weight	16oz (0.45kg)

Additional Data. The FLAC-300 Flasher is procured by term contract from the manufacturer, Tideland Signal Corporation with a 1 year warranty from the date of purchase. Flashers purchased after 1 February 83 will be compatible with the type-L daylight control. Flashers purchased before this date were shipped with a Tideland daylight control. To modify these flashers to accept the type-L daylight control, contact COMDT G-EOF-4A.

Function. The FLAC-300, when used in conjunction with the CG-4P lampchanger, will provide timed codes (flashes) to a wide range of flash characteristics. When used with the 120 volt AC, 250 watt lamp, this unit will take the place of the AC flash controller. A type-L daylight control is used to turn the light off during the daylight hours.

Features.

- * All electrical components are solid state
- * Non adjustable
- * CG standard and nonstandard simple characteristics available
- * CG standard and morse type complex characteristics available
- * Water tight non metallic container
- * Gold plated electrical contacts
- * Replacable plug-in circuit cards



Figure 6-68 FLAC-300 PARTS

CHAPTER 7 SOUND SIGNALS

Electronic sound signals and related equipment are described in this chapter. Wave-actuated sound signals are covered in Chapter 2.

A sound signal, consisting of an emitter and a power supply, is selected according to the timing characteristic desired and the specific use--fixed or on a buoy. Fixed installations must consider location, adjacent structures, foundations, horizontal alignment, noise pollution, and nearest residences. Buoy installations are on either standard buoys or large navigational buoys (LNB) and must consider location, noise pollution, and nearest residences.

Sound signals have varying ranges (in nautical miles) and give directional or omnidirectional coverage. The ELG-500/02 and ELG-500/04 are directional only; the FA-232 and FA-232/02 are omnidirectional, but can be made directional with plugs; the ELG-300/02 and ELG-300/04 are directional; and the SA-850, SA-850/02, ELU-300/02, ELU-300/04, and ELU-500/08 are omnidirectional only.

The power supplies for FA-232, FA-232/02, SA-850, and SA-850/02 sound signals are mounted within the emitter housing. Power supplies for the ELG-300/02, ELG-300/04, ELG-500/02, ELG-500/04, and ELU-500/08 are located in wall-mounted enclosures.

A temperature-controlled power factor corrector and a baffle are standard sound signal accessories. The temperature-controlled power factor corrector can be used to automatically change (according to variations in temperature) the power factor capacitors associated with the ELG or ELU emitters. The baffle can be used on any of the directional signals to help reduce noise pollution.

The definition of dBC, as used on the data sheets, is that specified by the American National Standards Institute (*Specification for Sound Level Meters*, S1.4-1971). All sound pressure levels are measured with a reference pressure of 20 micropascals.

A. SELECTION GUIDE

Timing Characteristics. The timing characteristic for any Coast Guard sound signal can be selected from the list of characteristics shown below. When two signals are in close proximity, their timing characteristics should be different.

Duty Cycle	Characteristic*
10%	1 ^s b1-9 ^s si
	3 ^s b1-27 ^s si
	3 ^s b1-3 ^s si-3 ^s b1-51 ^s si
13.3%	2 ^s b1-13 ^s si
	2 ^s b1-2 ^s si-2 ^s b1-24 ^s si
20%	2 ^s b1-2 ^s si-2 ^s b1-14 ^s si

Bells	Characteristic
Fixed	one strike every 10 sec
	one strike every 15 sec
Buoy	random

Use--Fixed or on Buoys. Sound signals within the Coast Guard aids to navigation system are classified for use in two broad areas--fixed or on buoys. For the given operational requirements, the choice of sound signal can be made using Table 7-1.

*Note: s = second, b1 = blast, si = silence.

Table 7-1
Sound Signal Selection Guide

USUAL RANGE FREQUENCY (Hz) WAVE ACTUATED		INPUT VOLTAGE											
		120 Vac											
		12 Vdc ³				24 Vdc ⁴							
		SA-850 ⁸	SA-850/02 ⁹	FA-232 ^{5,6,8}	FA-232/02 ^{5,9}	CG-300 ELG-500/2	TWO CG-300'S ELG 500/4	TWO SCR-600-CG'S ELU-500/08	CG-1000 ELU-300/02	TWO CG-1000'S ELU-300/04	CG-1000 ELG-300/02	TWO CG-1000'S ELG-300/04	
FIXED	1/4	390			OD-D								
	1/2	390			OD-D								
	1	390			OD-D								
		500 ¹					D						
	2	300						OD		D			
		500 ¹					D						
	3	300						OD		D			
		500 ¹						D					
4	300							OD			D		
BUOY	1/4	OTHER	OD										
		390 ²			OD								
		850	OD										
	1/2	390 ²			OD								
		850	OD										
1	850		OD										
LNB	1	500						OD					
	2	500						OD					
	3	500						OD					

KEY: OD = omnidirectional. Use omnidirectional only if 360-degree coverage is required. D = directional. A baffle can be used with any of the directional signals.

REFERENCE NOTES

1. Higher frequencies cause greater noise pollution. Signals of 500 Hz should be used as fixed signals only where a closely adjacent 300-Hz signal causes an operational need for a signal with a different tone.

2. FA-232 signals should not be used on the 1962-type, 8X26 buoy except where an SA-850 would produce intolerable noise pollution. When used on this buoy, the FA-232 signal and the buoy must be modified in accordance with Commandant (G-EDE) Drawing No. 120045.

3. These 12-Vdc signals can be made to operate on 120 Vac with the addition of a 120-Vac to 12-Vdc converter.

4. These signals require both a 24-Vdc battery and 120 Vac.

5. FA-232 signals are made directional by the addition of plugs.

6. FA-232 signals can be converted to a bell tone having a usual range of 1/4 nmi.

7. Usual range of a sound signal is the distance at which, in foggy weather, an observer has a 50 percent probability of hearing a sound signal when he is situated on the wing of a ship's bridge in an ambient noise level which is equal to or greater than that found on 50 percent of large merchant vessels, propagation between the sound signalling apparatus and the observer being effected in relatively calm weather, with no intervening obstacles (from *International Dictionary of Aids to Marine Navigation*, Chapter 3, IALA, 1970).

8. On SA-850's and FA-232's, a 6-db switch is used to change usual range from 1/2 to 1/4 nmi.

9. Usual range cannot be changed on the FA-232/02 and SA-850/02.

B. PREPARATION AND INSTALLATION

Equipment Inspection. All components of sound signal systems shall be inspected for damage upon receipt. Make a written record (with photographs) of any damage and notify the supplier, carrier, and other interested parties.

Emitter Installation

Acoustic Axis Orientation. Emitters must be mounted so that the acoustic axis* is parallel to the ground. For this reason, the emitter mounting surface shall be within ± 2.5 degrees of true horizontal. Emitters are free-standing and must be firmly attached to the mounting surface.

Fixed Installations

● Location. When the sound from a signal must travel over land, it may be attenuated and distorted as a result of vegetation or irregularities in the surface; thus, sound signals shall be placed as near to the water as possible, consistent with the need to protect the emitter

from storm damage. As a general guide, emitters should not be more than 100 ft from the water and should be located above the highest water that can be expected in the 10-yr storm.

● Adjacent Structures. Emitters shall be located at least four wavelengths (Table 7-2) away from any large reflecting surface, such as a wall (Figure 7-1). Any structural member in the arc of propagation must not exceed the size shown in Table 7-2 and Figure 7-1. Emitters shall not be placed in locations where weeds, tall grass, trees, or other vegetation are likely to attenuate or distort the signal.

● Foundations. Sound signal emitters are electromechanical vibrators. If mounted directly on a concrete foundation, the concrete must be reinforced with the equivalent of 6- by 6-in., 10/10 welded wire fabric.

● Horizontal Alignment. The acoustic axis of a directional signal shall be horizontally aligned in accordance with

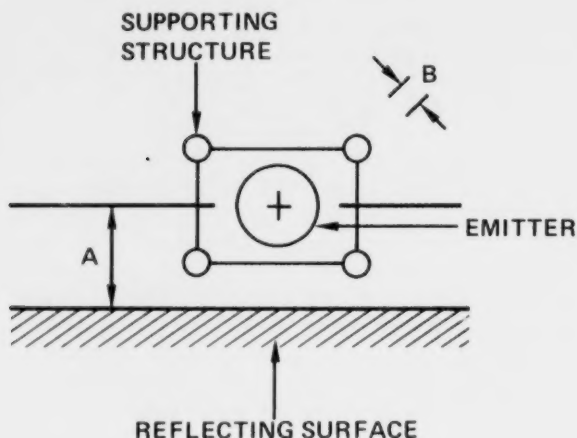
Table 7-2
Emitter, Frequency, and Wavelength Chart

Emitter	Frequency (Hz)	Wavelength (In.)	Minimum Distance (A)* to Large Reflecting Surface (e.g., wall), (In.)	Maximum Horizontal Width of Structural Member in the Prop- agation Path (In.)
FA-232	390	34	136	3.5
SA-850	850	16	64	2.5
ELG-300	300	45	180	4.0
ELG-500	500	27	108	2.5

*See Figure 7-1.

*On directional signals, the acoustic axis is a line; on omnidirectional signals, it is a horizontal plane.

Emitter Installation (cont'd)



Note: "A" is the minimum distance that the emitter is to be placed from a major reflecting surface, and "B" is the maximum dimension, measured radially, of the supporting structure.

Figure 7-1. Emitter location and structural dimensions.

the operational requirements of the signal. The FA-232 and FA-232/02 emitters can be converted to directional signals (Data Sheet 7-D(1), Figure 7-18) by the installation of plugs (Figure 7-19), which are available from the manufacturer. These plugs shall be installed as shown in Figure 7-2. CAUTION: The acoustic axes of all emitters used to make up a dual or multiple array must be parallel.

Buoy Installations

- Standard Buoys. Only those signals listed in Table 7-3 are authorized for installation on buoys. The drawings listed in the table are available upon request. Deviations from these drawings are prohibited unless approved by Commandant (G-EOE). After conversion, buoy designations shall be changed from "L" or "LR" to "LH" or "LHR."

- LNB's. The SCR-600-CG, ELU-500/08 system is the only sound signal authorized for installation on an LNB. Initial

installation of this equipment is described in section 9700 of Commandant (G-EOE) Purchase Description No. 265 of March 1973, entitled "Specifications for Hull, Machinery, and Equipment for Large Navigational Buoy, 40-Ft Discus, 1974 Class." This document is available from Commandant (G-EOE).

Power Supply Installation

Mechanical Installation

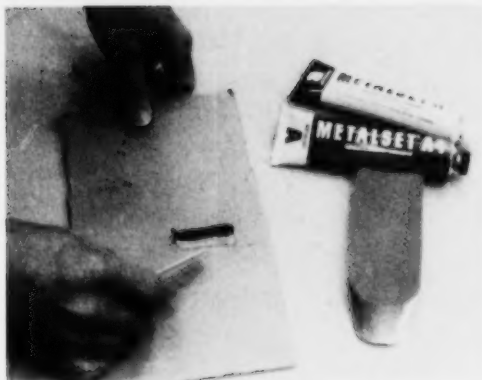
- FA-232, SA-850. The power supplies for the FA-232, FA-232/02, SA-850, and SA-850/02 sound signals are physically mounted within the emitter housing, as shown in Figures 7-3(a) and (b).

When converting the FA-232 pure tone to an FA-232 bell tone, the pure tone power supply and driver must be replaced by the bell tone generator and its accompanying driver (Figure 7-4).

- CG-Series Power Supplies. The CG-series power supply and its accessories are contained in a NEMA*-type wall-mounted enclosure. This cabinet is designed to be wall-mounted and, because of its weight, it must be attached to a structural element of the signal control standard volume. The power supply and its accessories shall be mounted inside this signal control standard volume. Chapter 7 of CG-250-41, *Automation Technical Guidelines*, gives further details on installation.

Mechanical installation of the temperature-controlled power factor corrector requires: (1) the removal of the power factor capacitors from the power supply and their placement in the power factor corrector cabinet, and (2) the addition of a thermistor within the emitter junction box (Figure 7-5). If the inside temperature is not within about 5 degrees

*National Electrical Manufacturers Association.



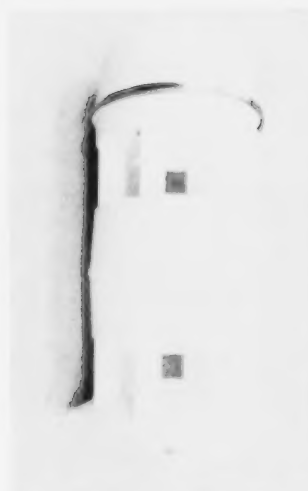
(a) Mix epoxy.



(b) Apply epoxy.



(c) Insert plug.



(d) Plugs are inserted in both ends.

Figure 7-2. Installation of plugs in the FA-232.

Table 7-3
Buoy Sound Signal Installation

<u>Signal</u>	<u>Buoy Types</u>	<u>Applicable Commandant (G-EOE) Drawing</u>
SA-850	6X20 L or LR	No. 120320
	7X17 L or LR	No. 120321
	8X26 L or LR	No. 120322
SA-850/02	8X26 L or LR	No. 120077
FA-232*	8X26 L or LR	No. 120045

*FA-232 signals were not designed for buoy use and modifications required are relatively expensive. For this reason, FA-232's are authorized only in those situations where SA-850's would create intolerable noise pollution.

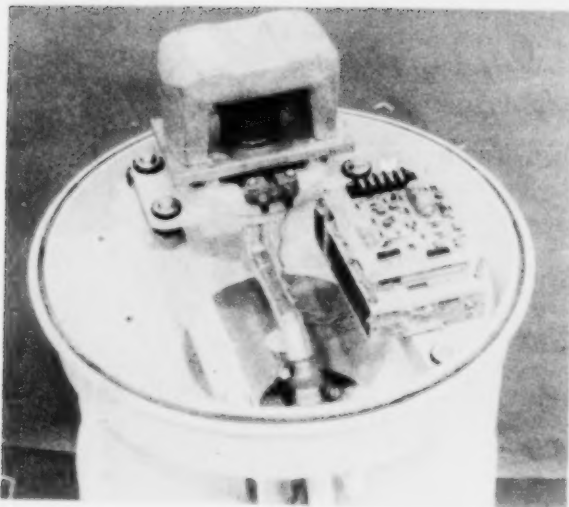


Figure 7-3(a). FA-232 power supply installation.

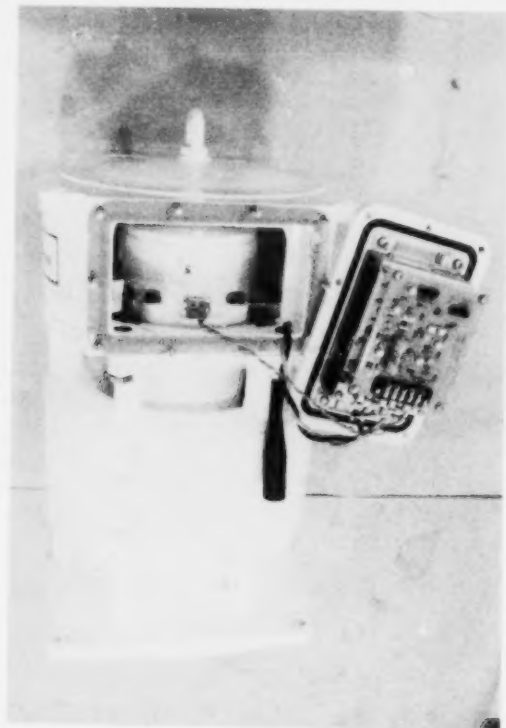


Figure 7-3(b). SA-850 power supply installation.

Power Supply Installation (cont'd)

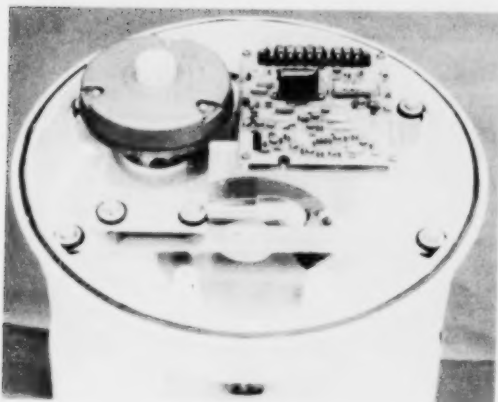


Figure 7-4. FA-232 bell tone installation.

of the outside temperature, the thermistor must be placed outside. (The waste heat from generators must be considered--it may cause a significant rise in the inside temperature.)

Electrical Requirements

• General. Wiring diagrams for the various sound signals and their accessories (Figures 7-6 through 7-17) are called out in Table 7-4.

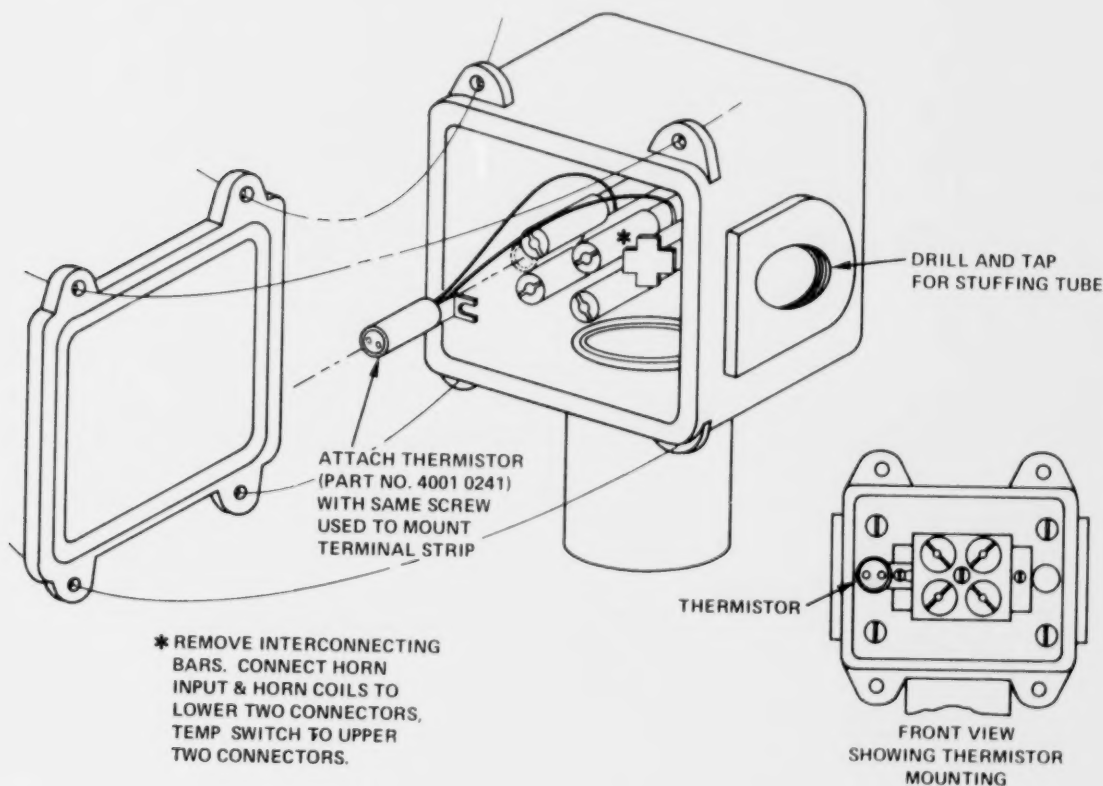


Figure 7-5. Modification of the emitter junction box to accommodate the thermistor.

Table 7-4
Sound Signal Wiring Diagram

TYPE OF SIGNAL			ACCESSORIES			
			TEMPERATURE-CONTROLLED POWER FACTOR CORRECTOR	AUDIO-VISUAL CONTROLLER	REMOTE CONTROL	STEP UP/STEP DOWN TRANSFORMER
FA-232	SINGLE	FIGURE 7-6	N/A	N/A	FIGURE 7-16	N/A
	DUAL	FIGURE 7-7	N/A	N/A	FIGURE 7-16	N/A
	BELL	FIGURE 7-8	N/A	N/A	N/A	N/A
SA-860	SINGLE	FIGURE 7-6	N/A	N/A	FIGURE 7-16	N/A
	DUAL	FIGURE 7-7	N/A	N/A	*	N/A
CG-300 **	SINGLE	FIGURE 7-9	FIGURE 7-13	†	FIGURE 7-17(a)	FIGURE 7-15
	DUAL	FIGURE 7-11	*	†	*	*
CG-1000 **	SINGLE	FIGURE 7-10	FIGURE 7-14	†	FIGURE 7-17(b)	FIGURE 7-15
	DUAL	FIGURE 7-12	*	†	*	*

*The wiring diagram for the single accessory system, plus the interconnecting wiring for the dual signal, should be used when accessories are used with dual signals; for example, when remote controlling the dual CG-1000, each power supply must be connected as shown for the single supply (Figure 7-17(b)).

**For minimum wire sizes, see Table 7-5.

†See Table 7-6.

Table 7-5
Minimum Wire Sizes for CG-Series Power Supplies

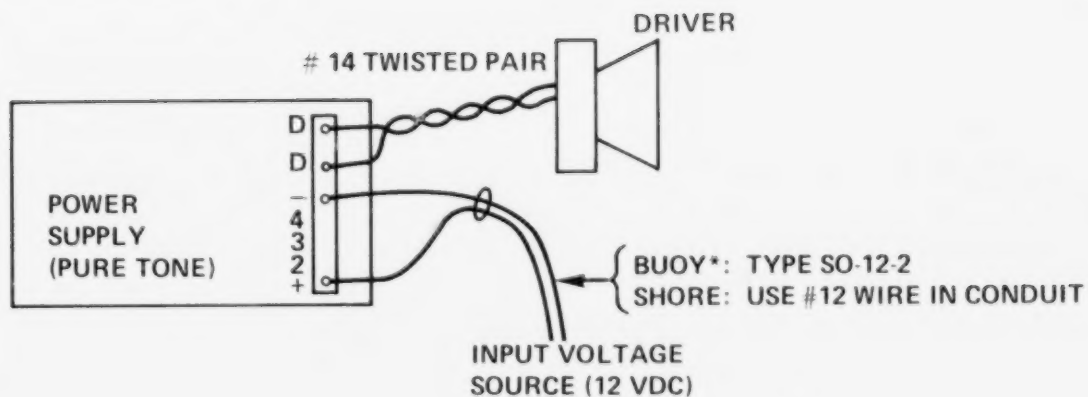
<u>Location of Connection</u>	<u>Wire Size</u>	<u>Maximum Cable Length (Ft)</u>
AC input	#12	20
DC input (if used)	#8	20
Interconnect (dual operation)	#14	20
Emitter	#10	200*

*See Figure 7-15.

Table 7-6
Standard Drawings*--A/V Controller with a CG-Series Sound Signal

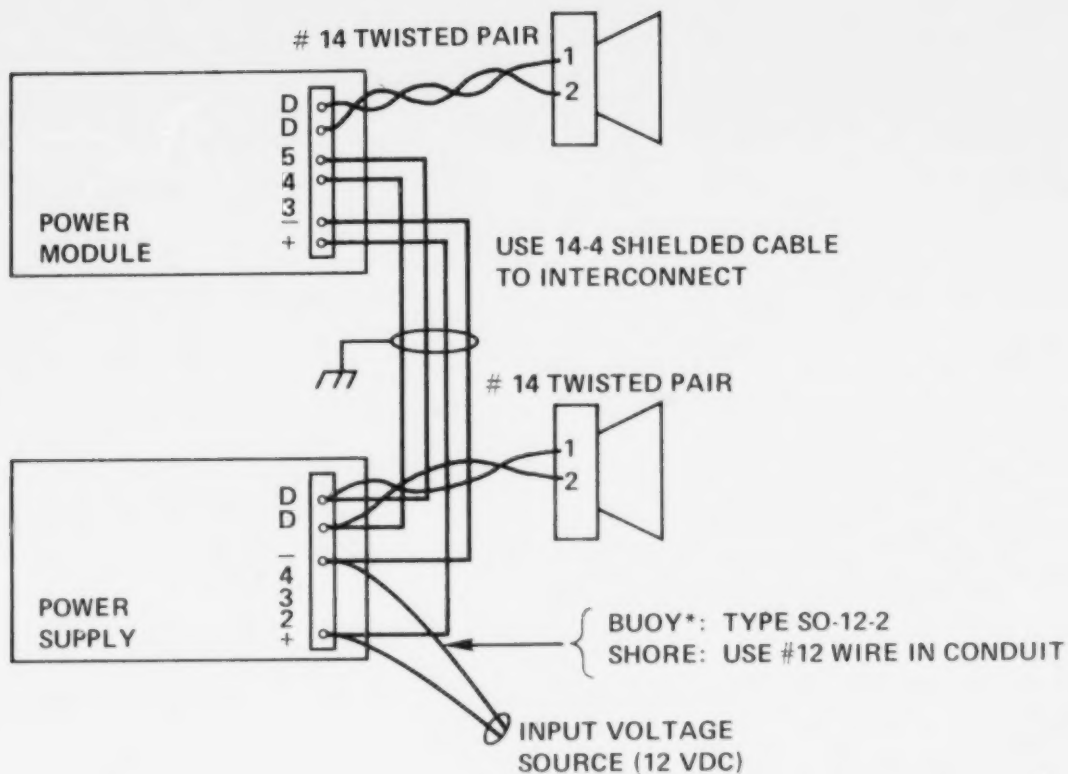
<u>Installation Drawing No.</u>	<u>Troubleshooting Drawing No.</u>	<u>Title</u>
130408	130708	Single CG-1000 with an emergency sound signal
130409	130709	Single CG-1000 without an emergency sound signal
130410	130710	Dual CG-1000 with an emergency sound signal
130431	130731	Single CG-300 with an emergency sound signal
130432	130732	Single CG-300 without an emergency sound signal
130433	130733	Dual CG-300 with an emergency sound signal

*Drawings available from Commandant (G-EOE).



*Refer to Chapter 2 of this manual for buoy wiring instructions.

Figure 7-6. Wiring diagram for the FA-232 and the SA-850.



Note: The polarity of the interconnections and connections ~~to the drivers~~ must be observed so that proper output can be obtained.

*Refer to Chapter 2 of this manual for buoy wiring instructions.

Figure 7-7. Wiring diagram for the FA-232/02 and the SA-850/02.

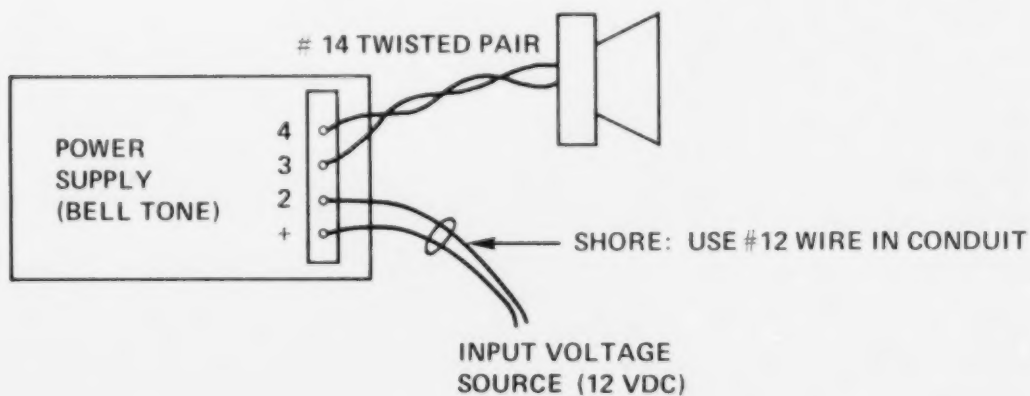
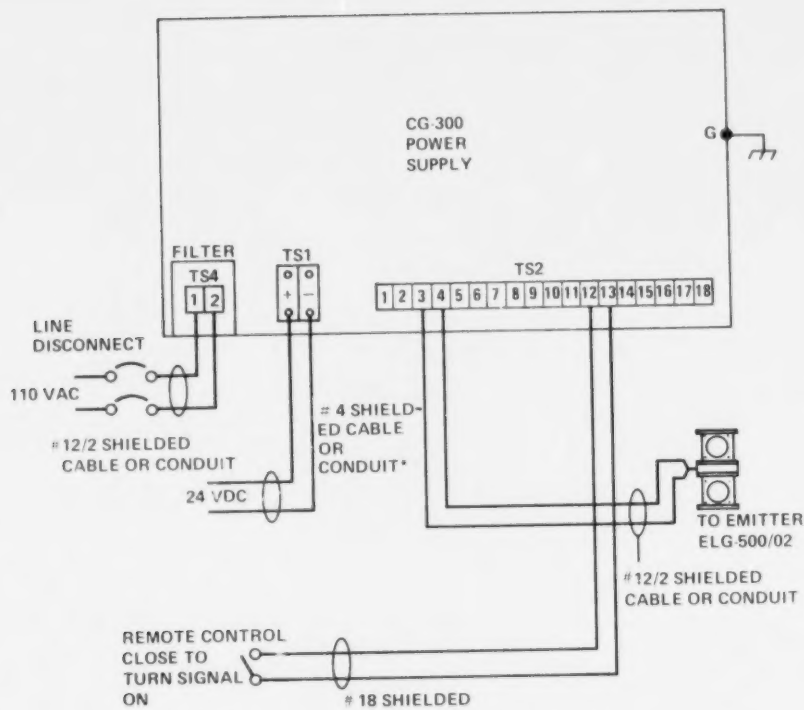


Figure 7-8. Wiring diagram for the FA-232 bell tone.



*Maximum cable length is 20 ft.

Figure 7-9. Wiring diagram for the single CG-300, ELG-500/02.

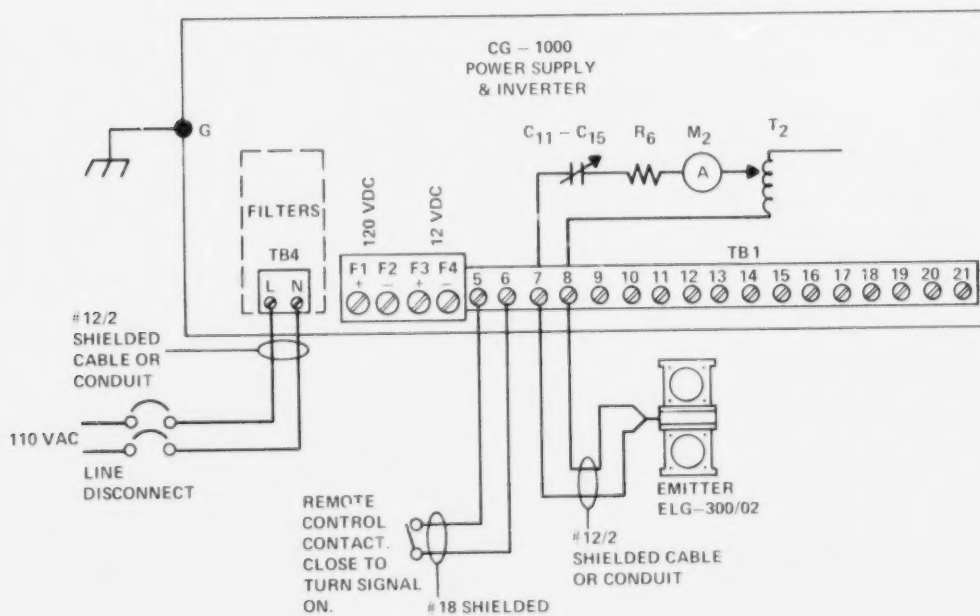


Figure 7-10. Wiring diagram for the single CG-1000, ELG-300/02.

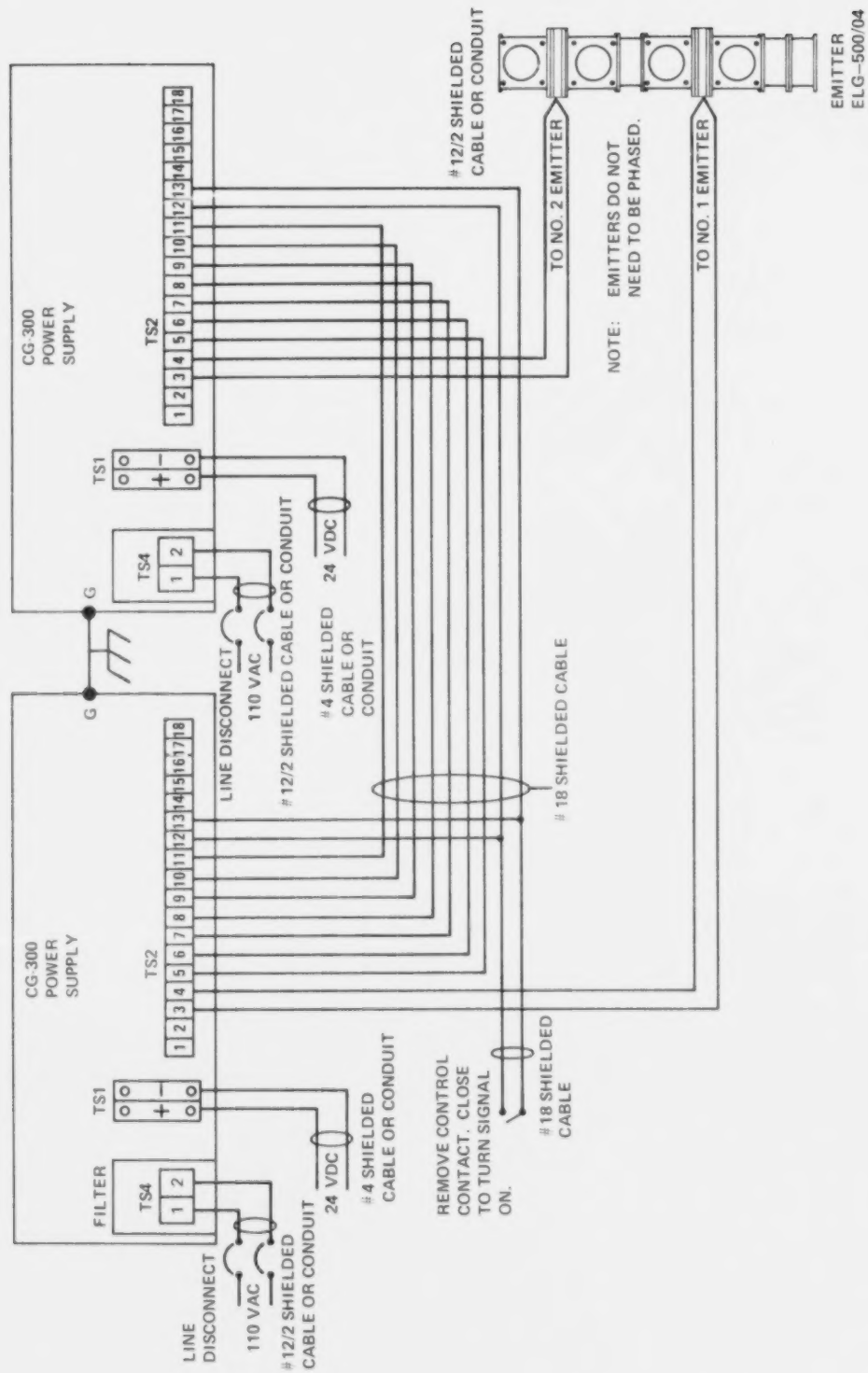


Figure 7-11. Wiring diagram for the dual CG-300, ELG-500/04.

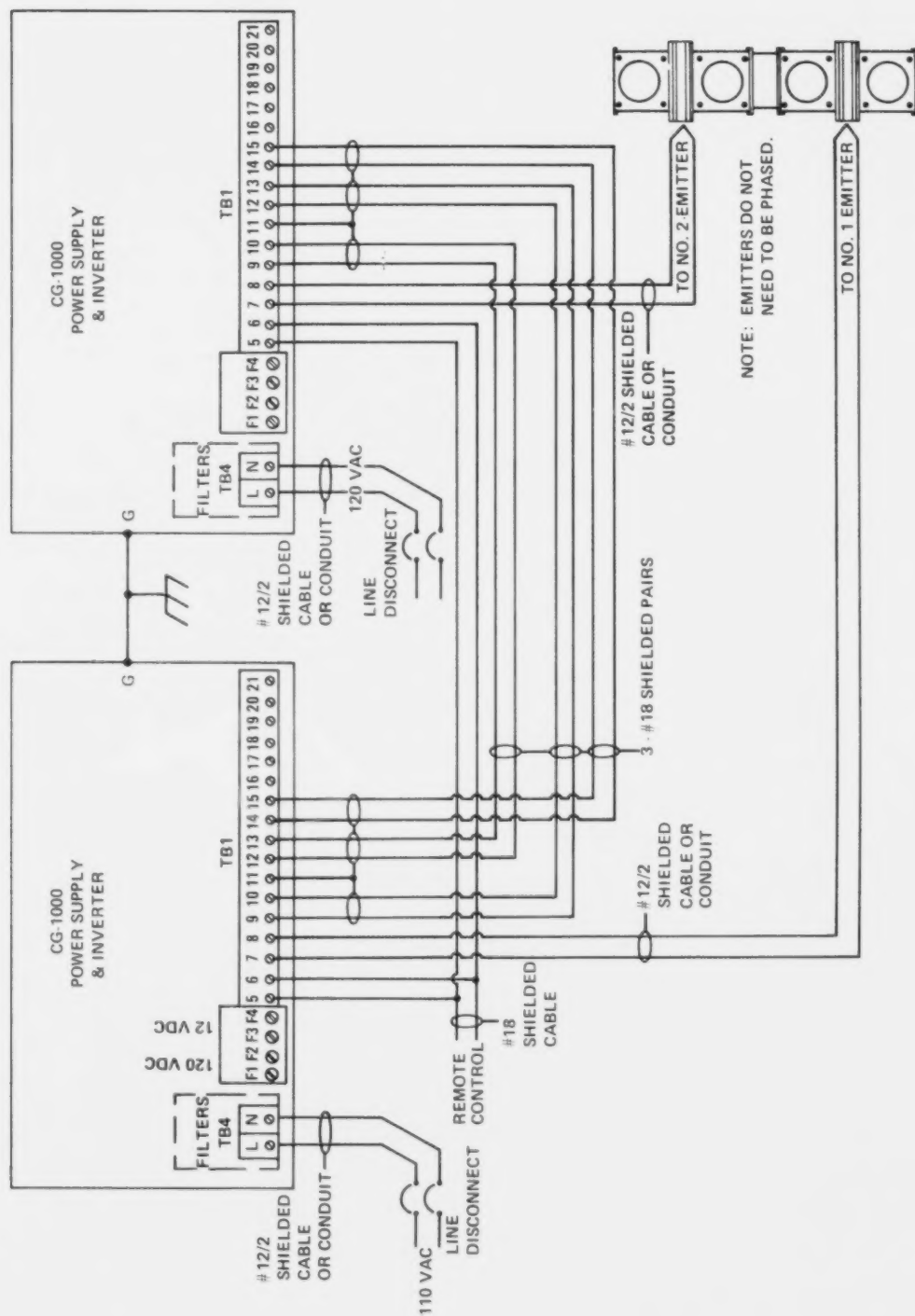
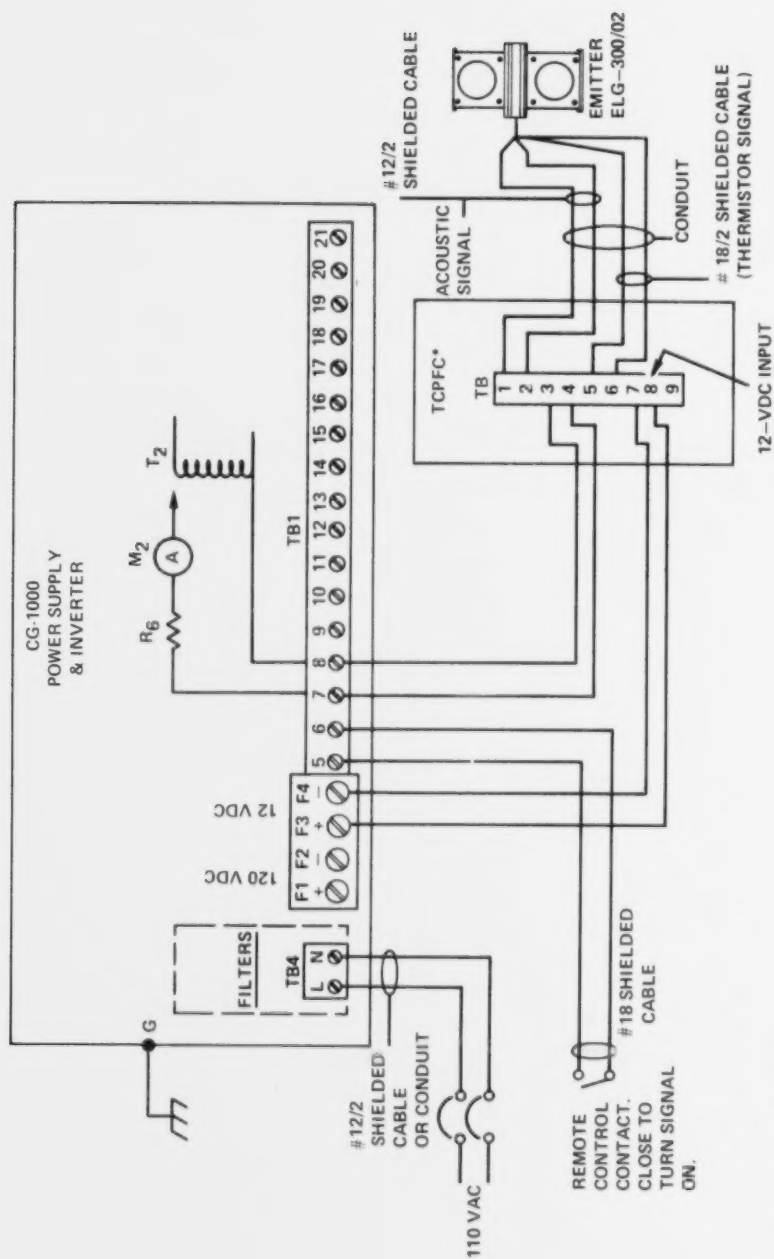


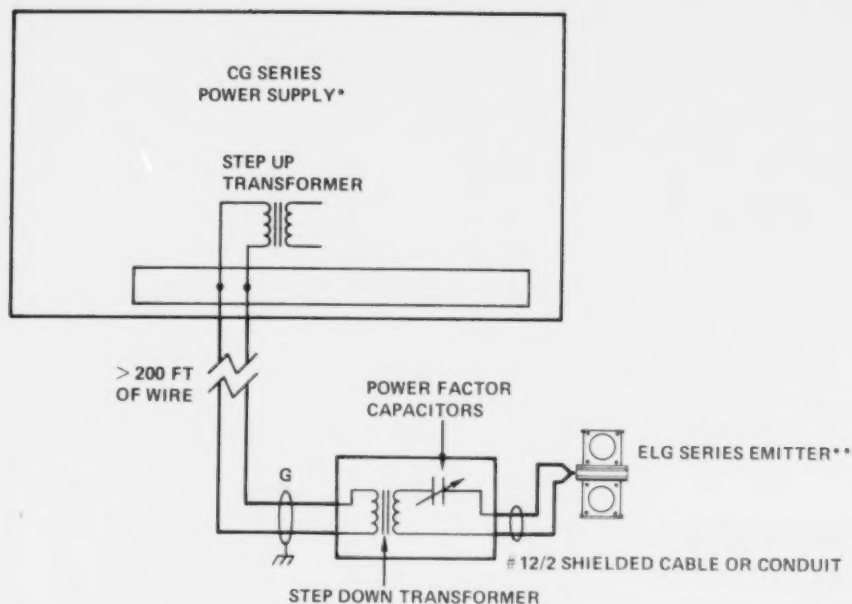
Figure 7-12. Wiring diagram for the dual CG-1000.



Note: When using the temperature-controlled power factor corrector, remove the power factor capacitors from the CG-1000 power supply and put them into the power factor corrector cabinet.

*Temperature-controlled power factor corrector.

Figure 7-14. Wiring diagram for the temperature-controlled power factor corrector added to the CG-1000 system.

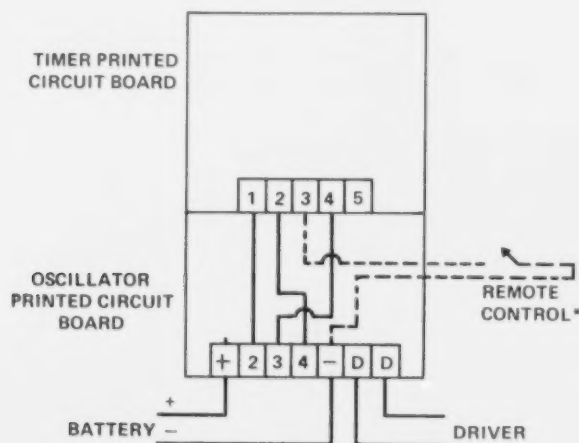


Note: When these transformers are used, the power factor capacitors must be moved from the power supply location to the emitter location. A watertight NEMA enclosure shall be used for this purpose.

*CG-300 or CG-1000 power supply.

**ELG-500/02 or ELG-300/02 emitter.

Figure 7-15. Wiring diagram for a step up/step down transformer pair.

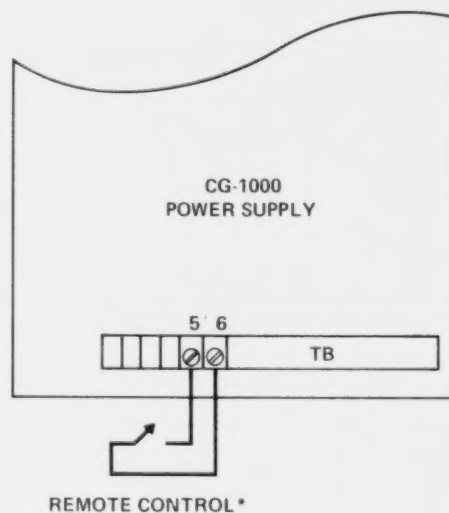
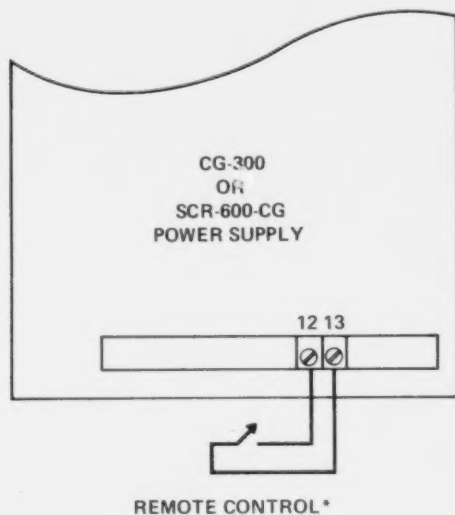


Note: If continuous operation is desired, the remote control switch must be normally open. A closed switch will turn the signal off.

*Close contact to turn signal off.

Figure 7-16. Remote control connections for the FA-232 (pure tone) and the SA-850.

Power Supply Installation (cont'd)



*A NORMALLY CLOSED switch is required for continuous operation. An open switch causes the power supply to cease operation.

Figure 7-17(a). Remote control connections for the CG-300 and SCR-600-CG power supply.

Figure 7-17(b). Remote control connections for the CG-1000 power supply.

● Remote Control. All sound signal systems described in this manual have two basic modes of operation--continuous or remote control. Remote control is defined as any external switch that activates or deactivates the signal, such as a fog detector, telephone-controlled relay, or a radio link. Each signal is provided with a pair of terminals that is used for remote control connections.

Characteristic Timing

● FA-232, SA-850. The timing characteristic for the FA-232, the SA-850, the FA-232/02, or the SA-850/02 can be changed at the time of installation, if necessary. In order to obtain the correct characteristic, the appropriate diodes and jumper wires must be installed in accordance with the information supplied in the manufacturer's instruction book.

● CG-Series Supplies. The characteristic timing of any of the CG-series power

supplies can be changed by replacing the coding timer.

Output Level

● FA-232, SA-850. At the time of installation, the output sound pressure level can be lowered by 6 dB by placing the output level switch in the "LOW" position. This reduces the usual range of these signals from $\frac{1}{2}$ nmi to $\frac{1}{4}$ nmi. This level (or usual range) is to be set as specified by SANDS forms. When installing either the FA-232/02 or the SA-850/02, the level switch of the power supply must be left in the "HIGH" position.

● CG-Series Systems. The "horn level" control and the power factor capacitors require special adjustments during installation. The horn level control adjusts the output current, which ultimately sets the range of the signal (Data Sheet 7-D(3), Figure 7-26; Data Sheet 7-D(4), Figure 7-31; Data Sheet 7-D(5), Figure

Power Supply Installation (cont'd)

7-36). This current is to be set as specified by SANDS forms.

Power factor correction is usually set at the factory, but power factor adjustment is required when the emitter tone warbles, when the adjustment of the output level control will not maintain the proper output current, or when the voltages shown in Table 7-7 cannot be obtained.

Internal Battery Charger Settings for the CG-300 and the SCR-600-CG. Refer to the battery manufacturer's instructions

and Chapter 9 of this manual for float voltage, rate of charge, specific gravity checks, and equalizing charging. The CG-300 and SCR-600-CG power supplies have provisions for setting float and equalizing charges. The factory setting for both is for lead-acid storage batteries of the lead-antimony type. A timer is provided for equalize charging. It can be set for any equalizing charge time up to 24 hr. When it times out, the charger automatically reverts to the float setting.

Table 7-7
CG-Power Factor Voltages

	CG-300 ELG-500/02	SCR-600-CG ELU-500/04*	CG-1000, ELG-300/02 or ELU-300/02
Power factor	0.8	0.8	0.8
Emitter voltage	350-400	350-400	350-400
Capacitor voltage	325-375	325-375	325-375
Voltage difference	25-50	30-50	35-55
ΔV^{**}	Not available	Not available	20

*The voltages shown are applicable for each emitter being driven by the power supply.

**This voltage is the number of volts that will be added or subtracted with a 1 μ F change to the power factor capacitor bank.

C. INSPECTION, MAINTENANCE, AND REPAIR ON STATION

Inspection. Sound signal inspection and preventive maintenance shall be accomplished on a semiannual basis or as indicated in Table 7-9.

components. On-station repair of printed circuit boards is prohibited. To protect hearing, see Table 7-8 when working near operating sound signals.

Maintenance Policy. All sound signal maintenance and repair on station shall be accomplished by module replacement only. Module replacement refers to replacement of printed circuit boards, transformers, and other major

Additional Information. For information on maintenance and repair that is not covered in this manual, consult the manufacturer's instruction booklet and Aids to Navigation School Publications.

TABLE 7-8
SOUND SIGNAL MINIMUM SAFE DISTANCES FOR PERSONNEL
NOT WEARING HEARING PROTECTION

<u>Sound Signal Apparatus (dba @ 1 meter)</u>	<u>Minimum Safe Distance in ft.</u>
1. FA-232 (118 dbA)	50
2. FA-232/02 (124 dbA)	90
3. SA-850 (119 dbA)	50
4. SA-850/02 (125 dbA)	100
5. ELG-300/02 (136 dbA)	370
6. ELG-300/04 (140 dbA)	580
7. ELG-500/02 (134 dbA)	290
8. ELG-500/04 (140 dbA)	580
9. ELU-500/08 (136 dbA)	370
10. Air Horns (155 dbA max)	3300

NOTES:

1. If personnel must work closer to an operating sound signal than the "minimum safe distance", then authorized ear protection (see page 7-22) must be worn.
2. If personnel must work closer than 25 ft. from any of the last six signals, the power valve or switch (air or electrical) or panel door providing access shall be locked with power to the signal secured. The worker shall keep the key to the padlock in his possession. The lock shall be tagged "Secured-Man working on Sound Signal". Electrical lock switches are standard navy stock. Electrical lockouts may be obtained locally.
3. The minimum safe distances have been calculated for a 10% duty cycle. For 15% and 20% duty cycles the minimum safe distances will be increased by 24% and 42%, respectively.

Hearing Protection Devices. Ear plugs and ear muffs reduce ambient noise by approximately 30 decibels (db) and the minimum safe distances by 90 percent. Plain cotton will not provide any hearing protection whatsoever. The following are applicable stock numbers (NSN) for the authorized hearing protection devices:

David Clark Muff	4240-00-759-3290
Replacement Seal	4240-00-979-4040
E-A-R Ear Plugs, universal, disposable, boxed 200 pairs	6515-00-137-6345

Hearing Conservation Program. When personnel are routinely exposed to hazardous noise levels (with or without) hearing protection a hearing conservation program must be

implemented in accordance with COMDTINST M5100.29, Safety and Occupational Health Manual. Audiometric testing shall be performed in accordance with COMDTINST M6260.15, Occupational Medical Monitoring Manual.

Sound Signal Warning Signs. To prevent hearing loss to casual visitors near sound signalling apparatuses, warning signs visible from any approach shall be posted on or near the signal and shall read:

DANGER
INTENSE SOUND SIGNAL
MAY SOUND WITHOUT WARNING
KEEP 100 FEET AWAY
WHEN HORN SOUNDS

They are available from COMMANDANT G-EOE-4A.

Table 7-9
Sound Signal Inspection Chart

EQUIPMENT TASK	EQUIPMENT										NOTES
	FA-232	FA-232/2	SA-850	SA-850/2	CG-300	SCN-400-CG	CG-1000	ELU (ELU-300-22)	ELU (ELU-300-173)	ELU-300/24	ELU-300/28
CHECK CHARACTERISTIC	*	*	*	*	*	*	*				
CHECK INPUT VOLTAGE	11-18 Vdc	11-18 Vdc	11-18 Vdc	11-18 Vdc	120 Vdc 24 Vdc	120 Vdc 24 Vdc	120 Vdc				
REPLACE OIL-FILLED FILTERS						D					
CHECK EMITTER VOLTAGE	20-30 Vdc	20-30 Vdc	20-30 Vdc	20-30 Vdc				S 300-400 Vdc	S 300-400 Vdc	S 300-400 Vdc	D-S 300-400 Vdc
CHECK POWER FACTOR							S 120-376 Vdc				
CHECK CAPACITOR VOLTAGE							S 120-376 Vdc				
CHECK VOLTAGE DIFFERENCE							S 30-60 Vdc				
CHECK EMITTER CURRENT							*				
CHECK EMITTER LEVEL SWITCH	*	*	*	*							
ADJUST EMITTER CURRENT MONITOR							*				
VERIFY THAT EACH EMITTER IS WORKING		*	*	*							
REMOVE DEBRIS FROM EMITTER	*	*	*	*							
CLEAN DRAIN HOLES											
REPLACE EMITTER											
CHECK BATTERY	*	*	*	*	*	±*					D
EQUALIZE BATTERY CHARGE					†	†					
SET EQUALIZE VOLTAGE					A	±A					
SET FLOAT VOLTAGE					*	±*					

KEY:
* EACH VISIT (SEMIANNUALLY OR UNSCHEDULED)
S SEMIANNUALLY, SPRING AND FALL
A ANNUALLY
D REGULARLY SCHEDULED DRY DOCK OF LNB
† AS NEEDED
± SEE LNB MAINTENANCE MANUAL

NOTES

2% TOLERANCE IS ALLOWED

WITH MULTIPLE ARRAYS,
EACH EMITTER MUST BE CHECKED

WITH MULTIPLE ARRAYS,
EACH EMITTER MUST BE CHECKED

WITH MULTIPLE ARRAYS,
EACH EMITTER MUST BE CHECKED

AS SPECIFIED ON SANDS FORMS

SINGLE SIGNALS, AS SPECIFIED ON SANDS FORMS;
DUAL SIGNALS, HIGH POSITION ONLY

REFER TO CHAPTER 8 FOR BATTERY MAINTENANCE

AS NEEDED

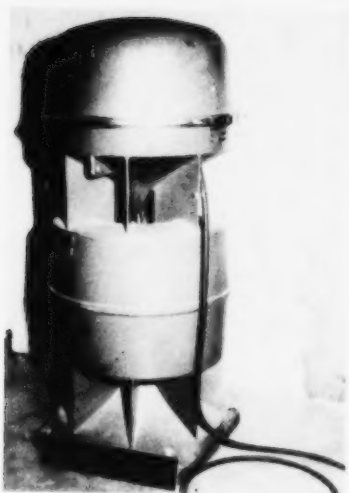
SET TO 28.0 ± 0.2 Vdc

SET TO 28.6 ± 0.08 Vdc

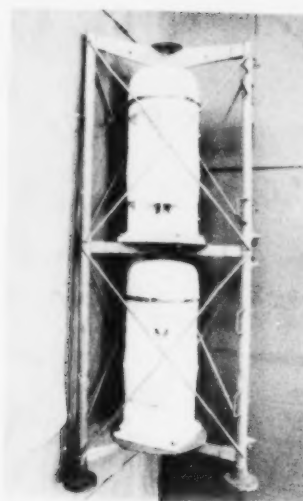
Note: For FA-232 and SA-850 sound signals, the voltage will be less than listed with the switch in the LOW position (approximately ½ times the voltage listed).

D. GENERAL DESCRIPTION DATA SHEETS

FA-232 AND FA-232/02



FA-232



FA-232/02

Function. The FA-232 and the FA-232/02 are sound signals with $\frac{1}{2}$ - and 1-nmi usual ranges, respectively. They can be used as the primary sound signal or the emergency backup signal at fixed locations or on structures.

These two signals are primarily used on stations where batteries are the only source of power. However, with the addition of a 120-Vac to 12-Vdc converter, both sound signals can be used on commercial power.

The FA-232 has been used on the 1962-type, 8X26 LR buoy, but authorizations for new buoy installations are limited.

Physical Characteristics

- Omnidirectional
- Directional (with plugs)
- Lightweight
- Compact and self-contained
- Corrosion resistant
- Waterproof
- 12-Vdc operation
- Low current drain
- Operates with any standard Coast Guard characteristics

Electrical, Acoustical, and Mechanical Characteristics

	FA-232	FA-232/02
Voltage source	12 Vdc	12 Vdc
Current drain	1.8 A	3.6 A
Acoustical level	122.7 dBC	128.7 dBC
Acoustical frequency	390 Hz	390 Hz
Weight	110 lb	700 lb
Duty cycle	20% maximum	20% maximum

Output Level. The output level of the FA-232 can be reduced to 116.7 dBC by using the switch on the electronic power supply. This reduces the usual range of the signal to $\frac{1}{4}$ nmi. The output level of the FA-232/02 cannot be reduced.

Directional Adaptation. The FA-232 and FA-232/02 signals can be made directional by using plugs (manufacturer's part no. 3030-0100). Figure 7-18 shows how the horizontal polar pattern is modified with the use of either three or four pairs of plugs (Figure 7-19).

Data Sheet 7-D(1). FA-232 and FA-232/02 sound signal systems.

Electrical, Acoustical, and Mechanical Characteristics (cont'd)

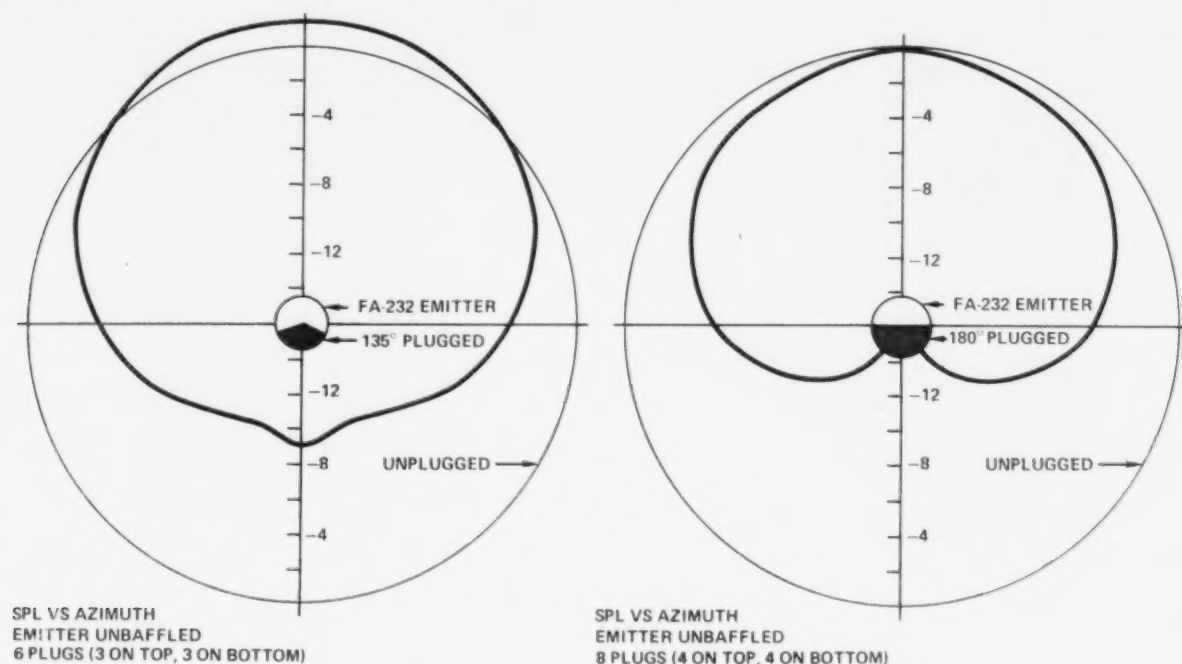


Figure 7-18. Polar plots for a plugged FA-232 or FA-232/02.



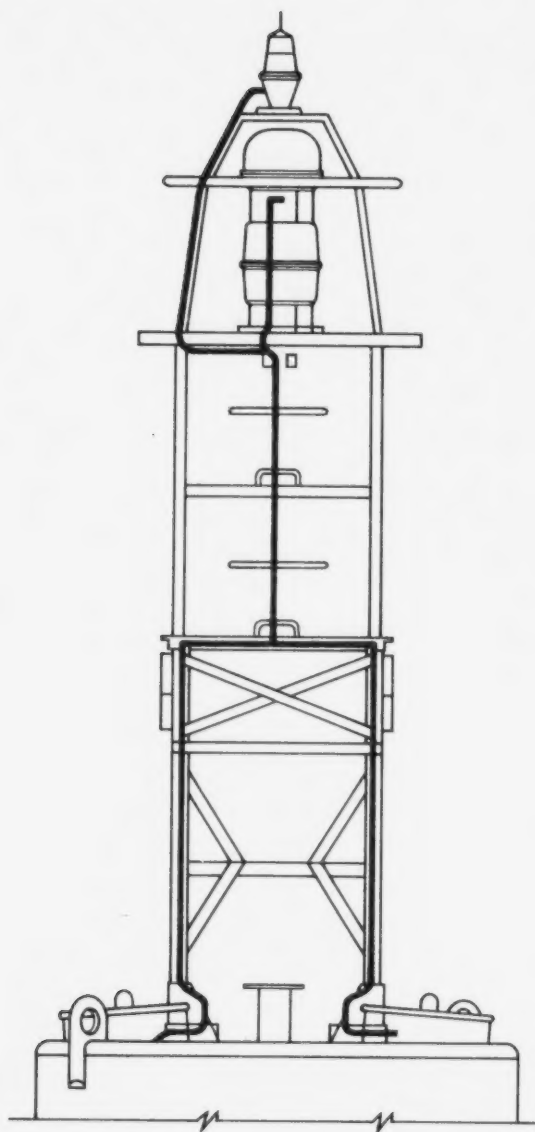
Figure 7-19. Plug kit, part no. 3030-0100.

Buoy Installations. The FA-232 emitter housing is constructed of fiberglass, which makes the signal lightweight, corrosion resistant, and durable on land stations only. When used on the 1962-type, 8X26 LR buoy, the FA-232 signal and the buoy must be modified in accordance with Commandant (G-EOE) Drawing No. 120045 (see Table 7-1). The signal must be modified with top braces and installed high in the cage of the buoy, as shown in Figure 7-20.

FA-232/02 Components. The FA-232/02 is never used on buoys. It is made up of two FA-232 fiberglass housings, two FA-232 drivers, one FA-232 electronic power supply, one power amplifier, and one galvanized steel tower. The special items (power amplifier and tower) are available from the manufacturer.

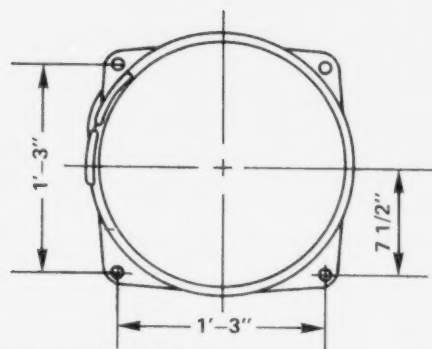
Dimensions. The dimensions of the FA-232 and the FA-232/02 are given in Figures 7-21 and 7-22.

Data Sheet 7-D(1). (cont'd).



Note: Modifications shall be made in accordance with Commandant (G-EOE) Drawing No. 120045. No appreciable degradation of stability will be noticed as a result of modifications.

Figure 7-20. Proper installation of the FA-232 on a 1962-type, 8X26 LR buoy.



4 7/8" DIA. MOUNTING HOLES

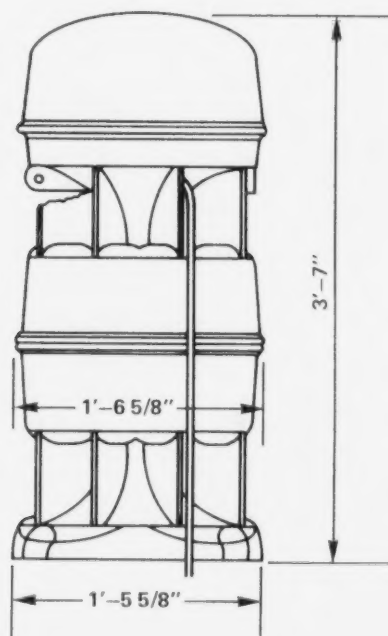


Figure 7-21. Dimensions of the FA-232.

Related Equipment. These signals are designed to be used as delivered; only a power source is required. They can be controlled by a fog detector, a telephone-controlled relay, or a radio link. When used as emergency backup signals, they are battery powered and controlled by the NAVAID sensor module through the audio-visual controller.

Related Equipment (cont'd)

When the FA-232 is used with the standard baffle, the sound pressure level (SPL) is reduced on the back side by approximately 30 dB. If the baffle is used with the FA-232/02, the metal tower arrangement shown in Figure 7-22 is not used.

Additional Data. The FA-232 pure-tone sound signal can be converted to a bell-tone type signal. This is done by replacing the existing power supply and the driver with the FA-232 bell-tone conversion assembly kit. For a single stroke per period, use manufacturer's part no. 1000-9106; for two strokes per period, use part no. 1000-9107; for three strokes per period, use part no. 1000-9108.

Manufacturer

Automatic Power, Inc.
P.O. Box 18738
Houston, Texas 77023

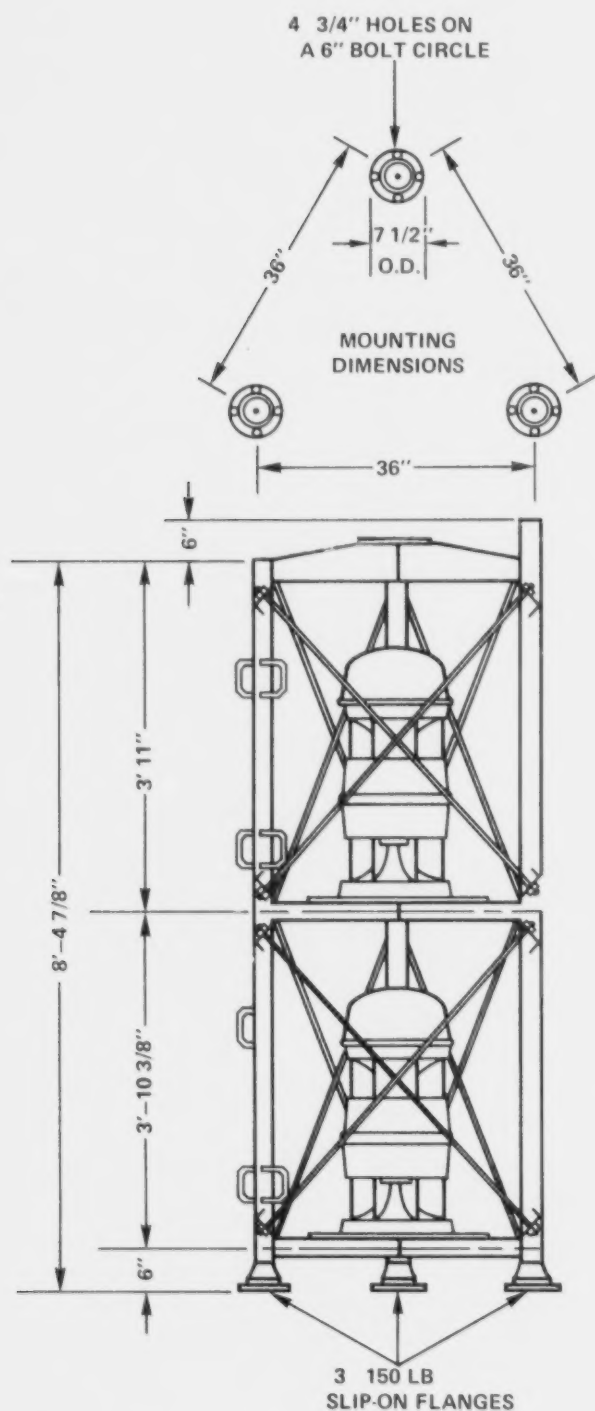
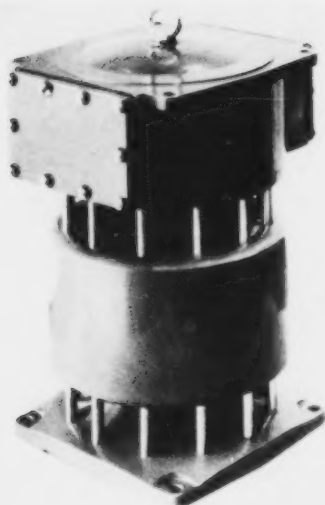


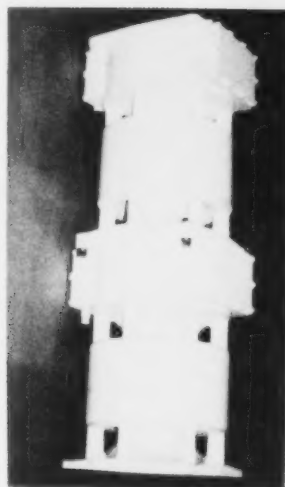
Figure 7-22. Dimensions of the FA-232/02.

Data Sheet 7-D(1). (cont'd).

SA-850 AND SA-850/02



SA-850



SA-850/02

Function. The SA-850 and the SA-850/02 are sound signals with $\frac{1}{2}$ - and 1-nmi usual ranges, respectively, that are used on buoys or in remote places. The SA-850 and SA-850/02 shall not be located nearer than 2 and $2\frac{1}{2}$ mi, respectively, from the closest residence. These distances shall be observed for either fixed or buoy installations.

Physical Characteristics

- Omnidirectional
- Lightweight
- Compact and self-contained
- Corrosion resistant
- Waterproof
- 12-Vdc operation
- Low current drain
- Operates with any standard Coast Guard characteristics

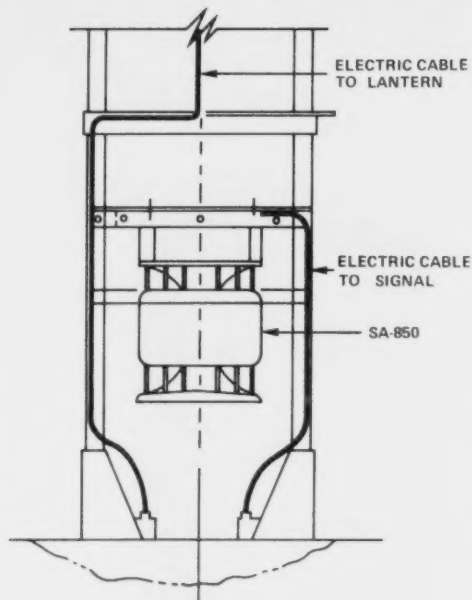
Electrical, Acoustical, and Mechanical Characteristics

	SA-850	SA-850/02
Voltage source	12 Vdc	12 Vdc
Current drain	1.25 A	3.25 A
Acoustical level	119.6 dBC	125.6 dBC
Acoustical frequency	850 Hz	850 Hz
Weight	128 lb	256 lb
Duty cycle	20% maximum	20% maximum

Output Level. The output level of the SA-850 can be reduced to 113.6 dBC by using the switch on the electronic power supply, which is behind the cover on the side of the emitter housing. This reduces the usual range of the signal to $\frac{1}{4}$ nmi. The output of the SA-850/02 cannot be reduced. Both signals are primarily used on stations where batteries are the only source of power.

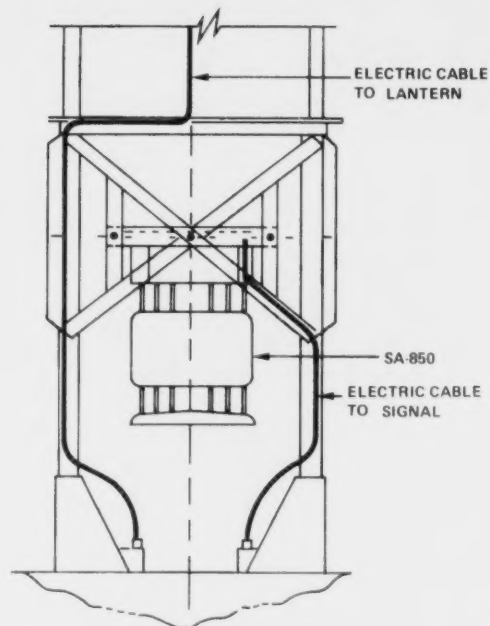
Buoy Installations. The SA-850 can be installed on 6X20 LR, 7X17 LR, and 8X26 LR buoys, as shown in Figures 7-23 (a), (b), and (c).

Data Sheet 7-D(2). SA-850 and SA-850/02 sound signal systems.



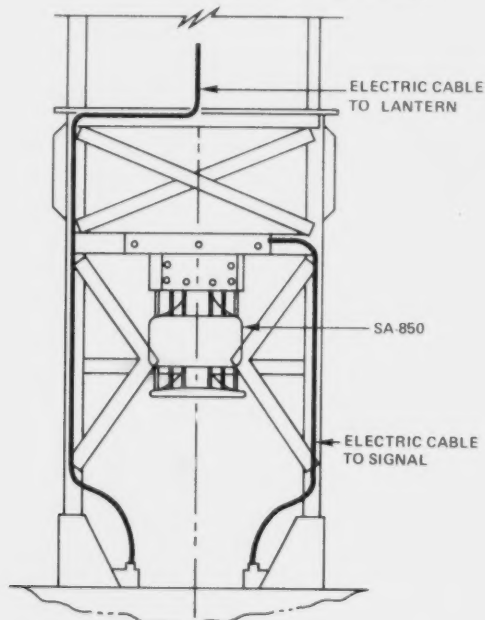
Note: Modifications shall be made in accordance with Commandant (G-EOE) Drawing No. 120320.

Figure 7-23(a). SA-850 installed on a 6X20 LR buoy.



Note: Modifications shall be made in accordance with Commandant (G-EOE) Drawing No. 120321.

Figure 7-23(b). SA-850 installed on a 7X17 LR buoy.



Note: Modifications shall be made in accordance with Commandant (G-EOE) Drawing No. 120322.

Figure 7-23(c). SA-850 installed on an 8X26 LR buoy.

Data Sheet 7-D(2). (cont'd).

Electrical, Acoustical, and Mechanical Characteristics (cont'd)

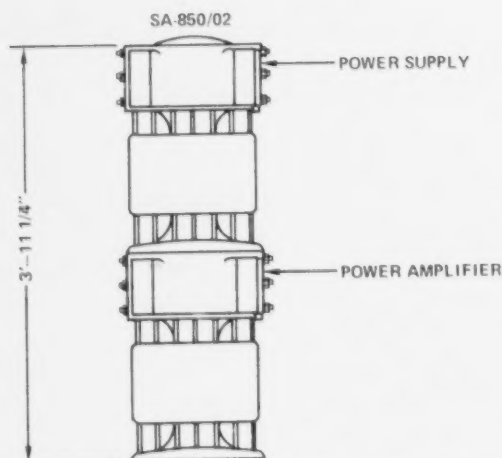
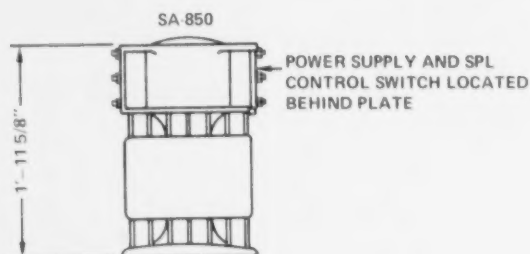
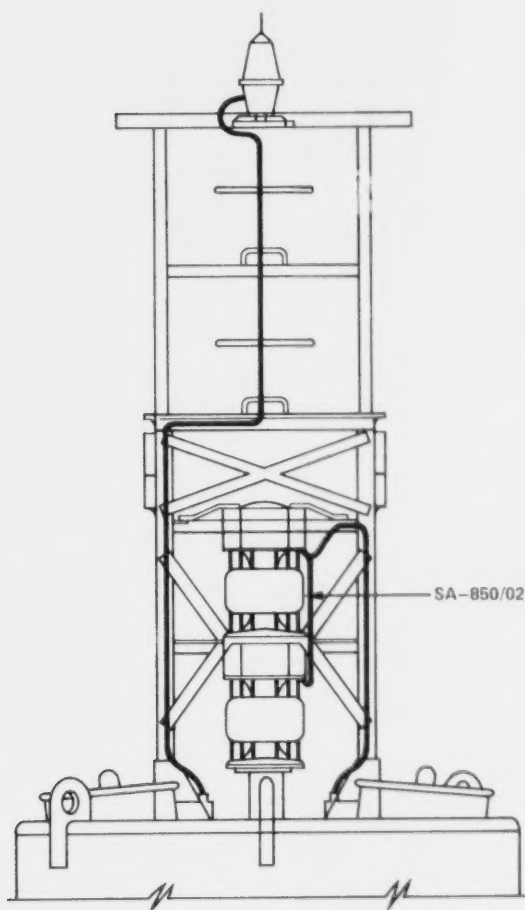
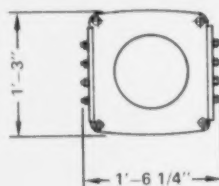
The SA-850/02 is made up of two SA-850 emitter housings bolted together (no additional supporting structure is needed), two SA-850 drivers, one SA-850 power supply, and one power amplifier. The amplifier is available from the manufacturer. The SA-850/02 signal shall be installed only on 1962-type, 8X26 LR buoys, as shown in Figure 7-24.

Dimensions. The dimensions of the SA-850 and SA-850/02 are shown in Figure 7-25.

Manufacturer

Automatic Power, Inc.
P.O. Box 18738
Houston, Texas 77023

TOP VIEW OF BOTH SIGNALS



Note: Modifications shall be made in accordance with Commandant (G-EOE) Drawing No. 120077.

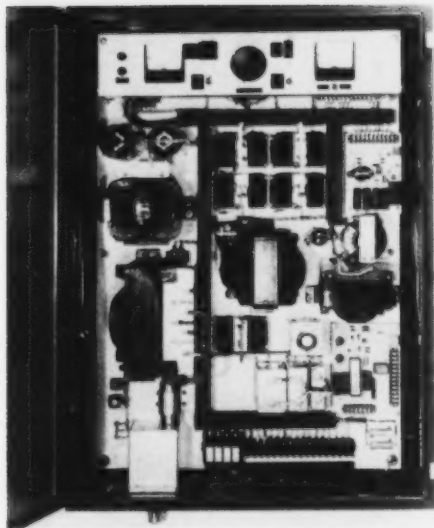
Figure 7-24. SA-850/02 installed on a 1962-type, 8X26 LR buoy.

Note: With the SA-850/02, there is no means of varying the output level or usual range.

Figure 7-25. Dimensions of the SA-850 and SA-850/02.

Data Sheet 7-D(2). (cont'd).

CG-1000, ELG-300/02



CG-1000 Power Supply



ELG-300/02 Emitter

Function. The CG-1000, ELG-300/02 sound signal system and the two CG-1000's, ELG-300/04 sound signal system are the standard 3- and 4-nmi sound signals, respectively. They are used as primary sound signals on shore stations or on structures and are never used on buoys.

Physical Characteristics

- Directional
- Omnidirectional (with ELU-300 emitter)
- Variable range
- 120-Vac operation
- Corrosion resistant
- Waterproof
- Operates with any standard Coast Guard characteristics

Electrical, Acoustical, and Mechanical Characteristics

	CG-1000, ELG-300/02	Two CG-1000's, ELG-300/04
Voltage source	120 Vac	120 Vac
Current drain		
(average)	17 A	34 A
(peak)	25 A	50 A
Emitter voltage	350-400 Vac	350-400 Vac
Emitter current	9.3 A	9.3 A (each supply)
Electrical frequency	150 Hz	150 Hz
Acoustical frequency	300 Hz	300 Hz
Acoustical level	143 dBC	147 dBC
Duty cycle	20% maximum	20% maximum
Emitter weight	496 lb	1,100 lb
Power supply weight	350 lb	700 lb

Data Sheet 7-D(3). CG-1000, ELG-300/02 sound signal system.

Electrical, Acoustical, and Mechanical Characteristics (cont'd)

Output Level. The output level of either the single or dual arrangement can be reduced by means of the horn level control on the meter panel of the power supply. The lowest output level at which the ELG-300/02 emitter will function is 132 dBC, which corresponds to an emitter current of 4 A. When the level is reduced, the usual range of the signal is correspondingly reduced, as shown in Figure 7-26. When two CG-1000 power supplies are used in parallel, both must be set to the same emitter current.

Directional Signals. The horizontal directivity patterns for the ELG-300/02 and the ELG-300/04 emitters are the same, as shown in Figure 7-27(a). The vertical patterns for the two emitters are significantly different, as shown in Figures 7-27 (b) and (c). (See Related Equipment for information on omnidirectional adaptation.)

Dimensions. The dimensions for the ELG-300/02 and ELG-300/04 emitters are shown in Figure 7-28. The ELG-300/04 emitter is made up of two ELG-300/02 emitters and

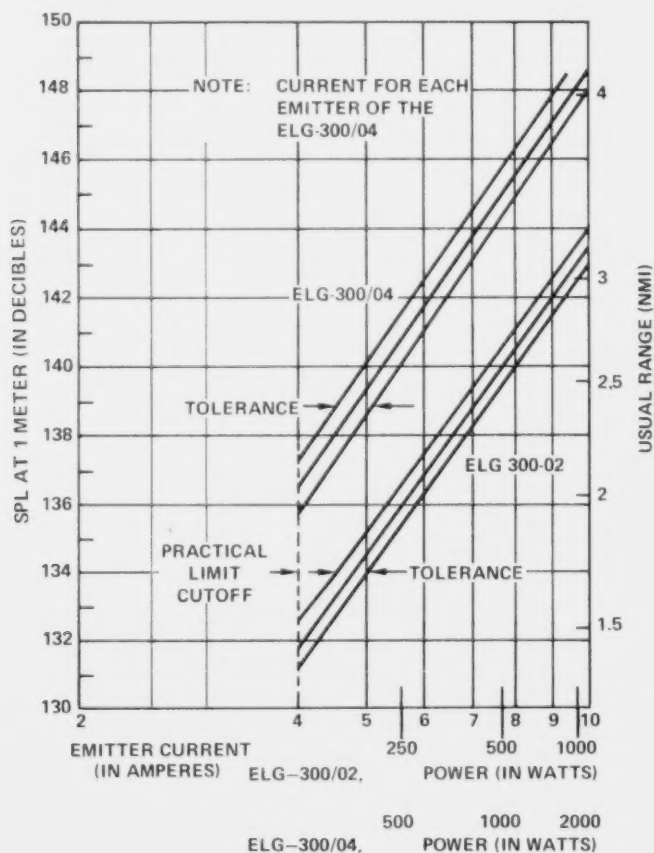
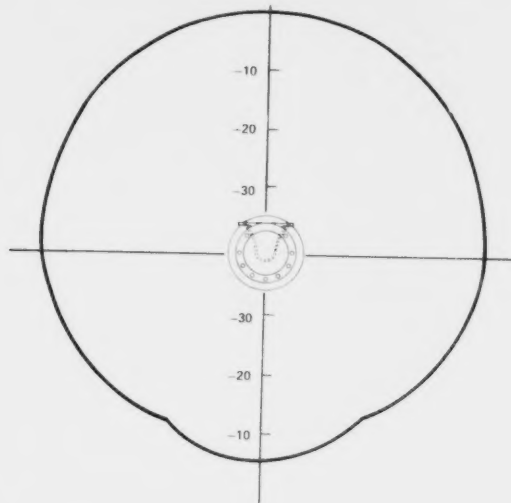


Figure 7-26. Input current and power to the emitter vs SPL for the ELG-300/02 and the ELG-300/04.

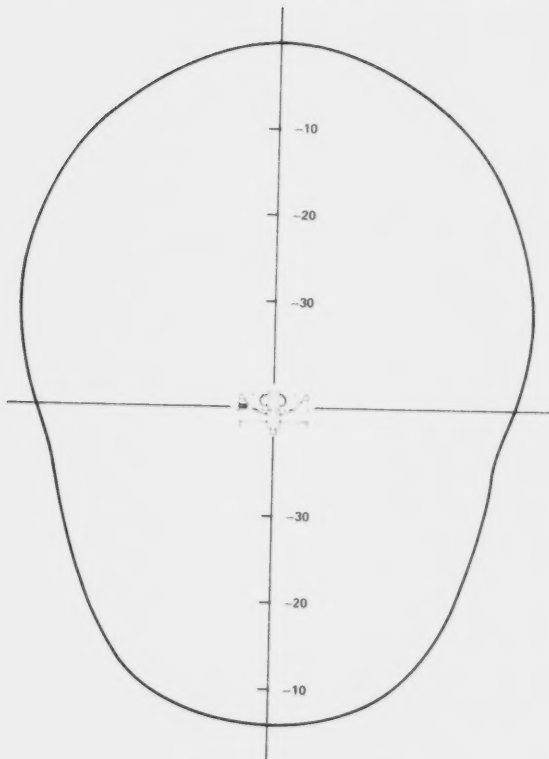
Data Sheet 7-D(3). (cont'd).

Dimensions (cont'd)

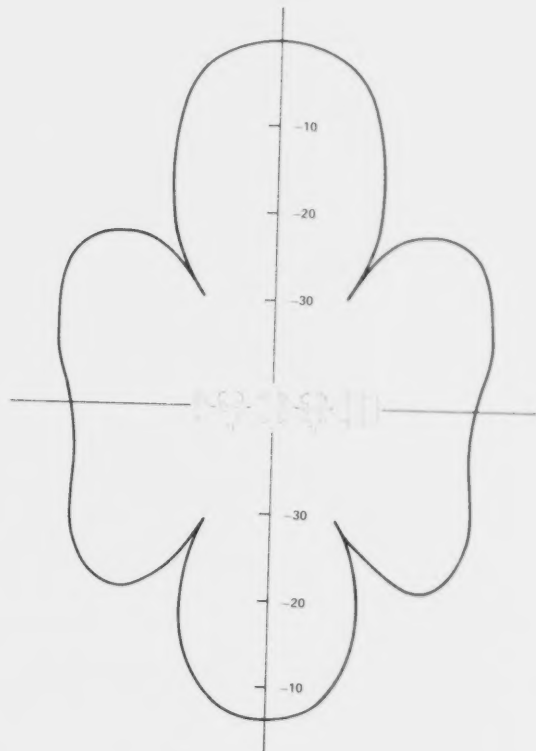
three spacers (Figure 7-28). CG-1000 power supply dimensions are given in Figure 7-29.



(a) Horizontal--ELG-300/02 and ELG-300/04



(b) Vertical--ELG-300/02



(c) Vertical--ELG-300/04

Figure 7-27. Horizontal and vertical directivity patterns for the ELG-300/02 and ELG-300/04 emitters.

Data Sheet 7-D(3). (cont'd)

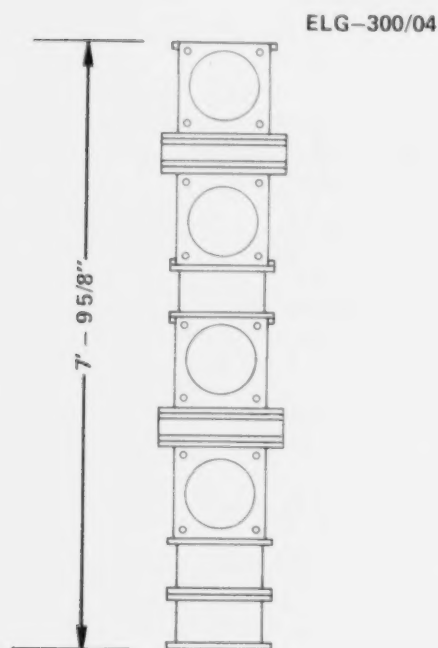
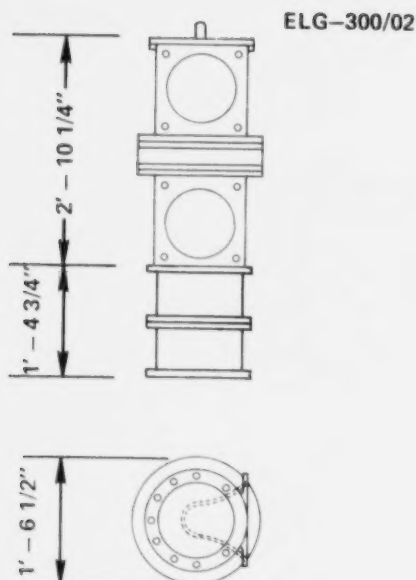


Figure 7-28. Arrangement and dimensions for the 300-Hz directional emitters.

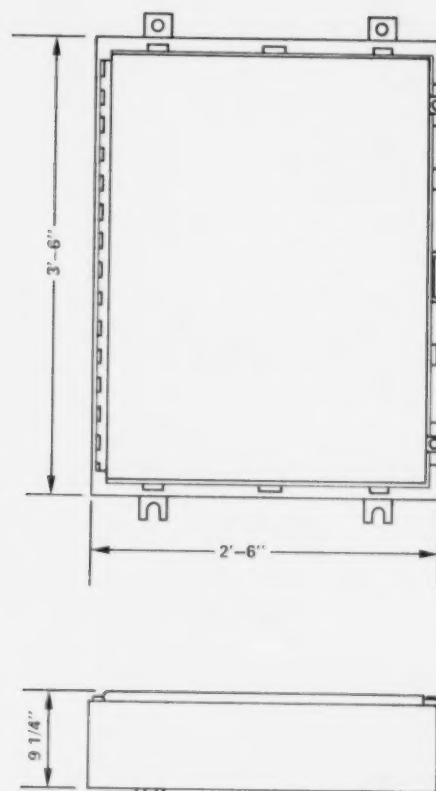


Figure 7-29. Dimensions of the CG-1000 power supply cabinet.

Related Equipment. These signals are designed to be used as delivered without supporting equipment other than the ac power source controls. They can be controlled by a fog detector or other remote means. Also, on aids where automatic transfer to a battery-powered emergency sound signal is required or where remote monitoring of sound signal status is necessary, these power supplies can be interfaced with the NAVAID sensor module through the audio-visual controller.

A baffle can be used to reduce the SPL on the back side of the emitter by approximately 30 dB.

Data Sheet 7-D(3). (cont'd).

Related Equipment (cont'd)

The CG-1000, ELG-300/02 and the two CG-1000's, ELG-300/04 signals can be made omnidirectional by using an ELU-300 emitter instead of the ELG-300 emitter. The effective usual ranges of the ELU-300/02 and ELU-300/04 emitters are the same as for the directional emitters--that is, 3 and 4 nmi, respectively. The dimensions for these emitters are shown in Figure 7-30.

The CG-1000 power supply can be used with the temperature-controlled power factor corrector equipment, described on Data Sheet 7-D(6).

Additional Data. The CG-1000, ELG-300/02 system has been purchased using Commandant (G-EOE) Purchase Description No. 213A.

An older version of the CG-1000 was called the SCR-1000. For most installations, the two power supplies are interchangeable.

Manufacturer

Automatic Power, Inc.
P.O. Box 18738
Houston, Texas 77023

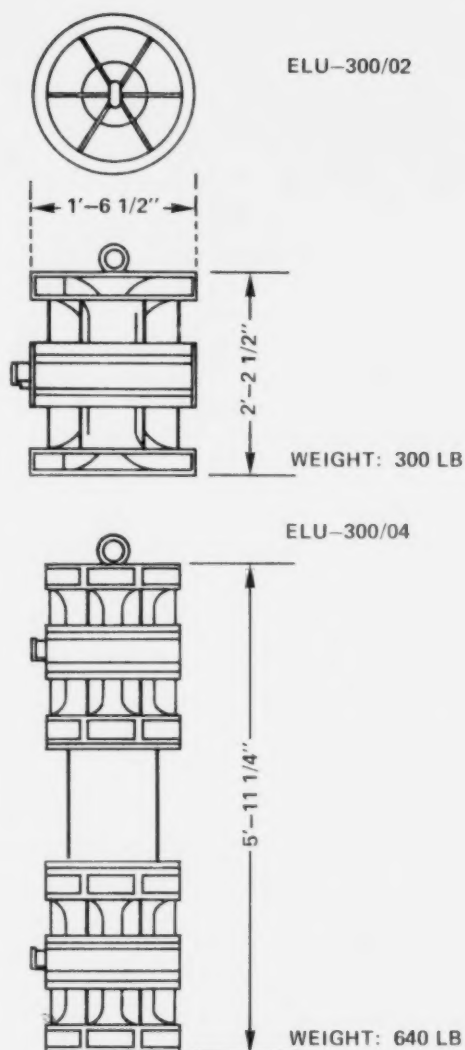
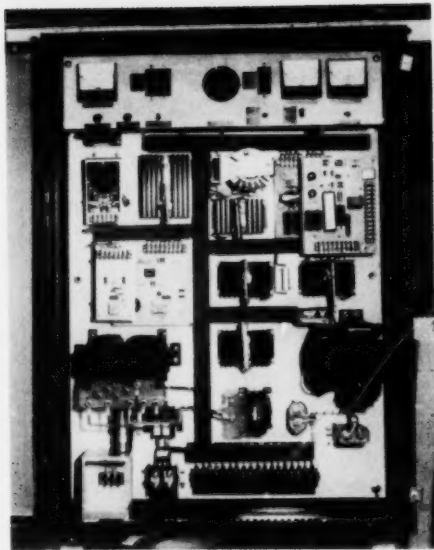


Figure 7-30. Weight and dimensions of the 300-Hz omnidirectional emitters.



CG-300 Power Supply



ELG-500/02 Emitter

Function. The CG-300, ELG-500/02 sound signal system is used as an alternate system for the FA-232/02 or SA-850/02 (with usual ranges of 1 nmi) or the ELG-300/02 (with a usual range of 2 or 3 nmi). The CG-300, ELG-500/02 is reserved for use in situations where use of the FA-232/02, SA-850/02, or ELG-300/02 signals could be confusing to the mariner. Such confusion could result if other 390-, 850-, or 300-Hz signals are in use nearby, regardless of the fact that they have different timing characteristics.

When used as a 3-nmi signal, the system consists of two CG-300 power supplies and an ELG-500/04 emitter; when used as a 1- or 2-nmi signal, the system consists of one CG-300 power supply and an ELG-500/02 emitter.

The use of either of these signals is to be minimized because of potential noise pollution caused by the 500-Hz pure tone. Whenever operational requirements permit, the signal should be used in conjunction with a baffle.

Physical Characteristics

- Directional
- Variable range
- Battery operated (24 Vdc)
- Built-in battery charger
- Battery equalization circuit
- Corrosion resistant
- Waterproof
- Operates with any standard Coast Guard characteristics

Electrical, Acoustical, and Mechanical Characteristics

	CG-300, ELG-500/02	Two CG-300's, ELG-500/04
Voltage source	24 Vdc	24 Vdc
Current drain (average) (peak)		
Battery charger (input voltage)	120 Vac	120 Vac

Data Sheet 7-D(4). CG-300, ELG-500/02 sound signal system.

Electrical, Acoustical, and Mechanical Characteristics (cont'd)

	CG-300, ELG-500/02	Two CG-300's, ELG-500/04
Battery charger (input current)	4 A	4 A (each supply)
(short circuit current)	30 A	30 A (each supply)
Emitter voltage	375 Vac	375 Vac
Emitter current	4 A	4 A (each supply)
Electrical frequency	250 Hz	250 Hz
Acoustical frequency	500 Hz	500 Hz
Acoustical level	137 dBC	143 dBC
Duty cycle	20% maximum	20% maximum
Emitter weight	80 lb	170 lb
Power supply weight	320 lb	640 lb

Input Power Requirements. A 24-V battery is required for normal operation of this system. The CG-300 power supply has a built-in battery charger to maintain the battery voltage at 26.8. A 24-V, 400-Ah battery will provide approximately 8 days of operation if the 120-Vac is disconnected.

Output Level. As indicated under Function, the usual range of this signal can be 1, 2, or 3 nmi. For a range of up to 2.5 nmi, a single CG-300, ELG-500/02 is used and the output is set according to that given in Figure 7-31. If a 3-nmi signal is required, two CG-300's and an ELG-500/04 are used and the emitter current for each supply is set to 4 A.

Directional Signals. The horizontal directivity patterns for the ELG-500/02 and the ELG-500/04 emitters are the same as shown in Figure 7-32(a). The vertical directivity patterns for the two emitters are significantly different, as shown in Figures 7-32(b) and (c).

Dimensions. The dimensions for the ELG-500/02 and ELG-500/04 emitters are shown

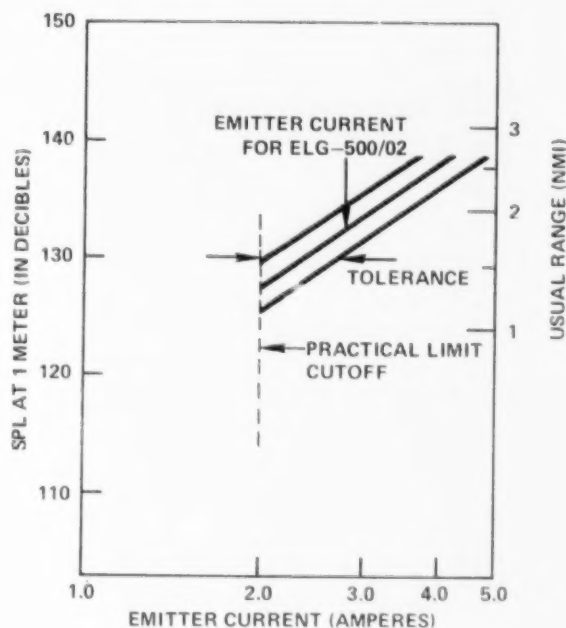


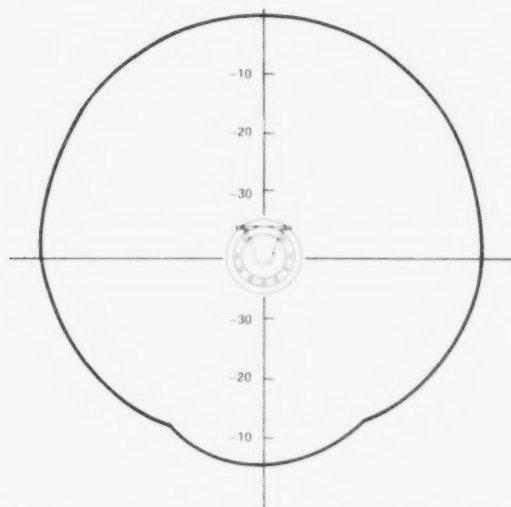
Figure 7-31. Input current and power to the emitter vs SPL for the ELG-500/02.

in Figure 7-33. The ELG-500/04 emitter is made up of two ELG-500/02 emitters and three spacers (Figure 7-33). CG-300 power supply dimensions are given in Figure 7-34.

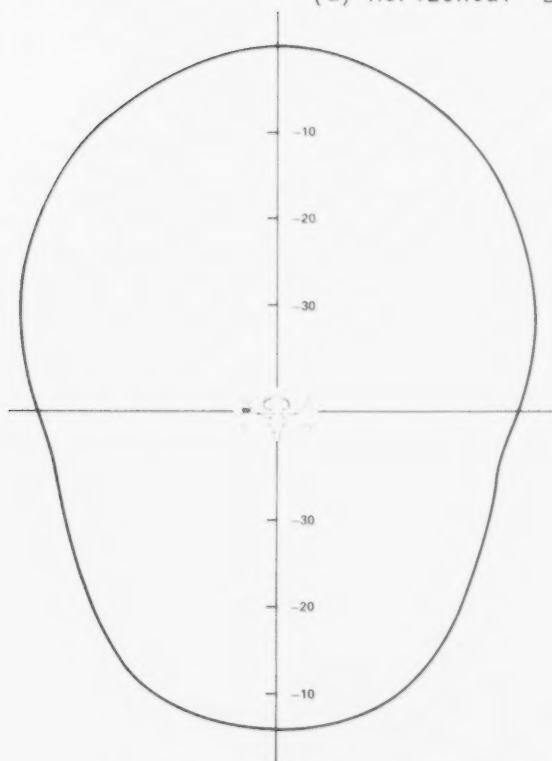
Related Equipment. These signals are designed to be used as delivered, with the addition of a 24-Vdc battery. They can be controlled by a fog detector or interfaced with the NAVAID sensor module through the audio-visual controller on aids where remote monitoring of sound signals is necessary.

A baffle can be used to reduce the SPL on the back side of the emitter by approximately 30 dB.

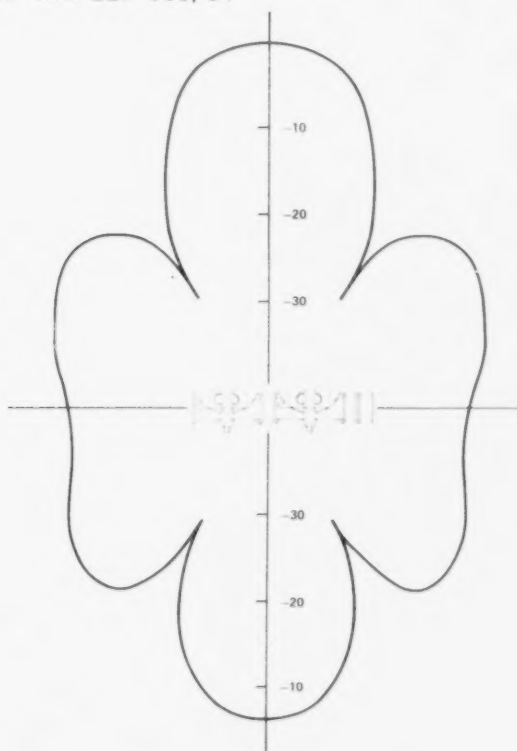
Additional Data. The older version of the CG-300 was designated as the SCR-300. For most installations, the two power supplies are directly interchangeable. Dimensions for the SCR-300 power supply are shown in Figure 7-35.



(a) Horizontal--ELG-500/02 and ELG-500/04



(b) Vertical--ELG-500/02

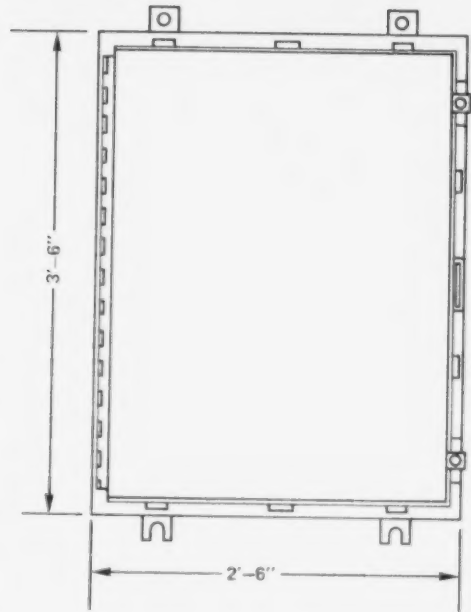
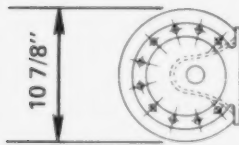
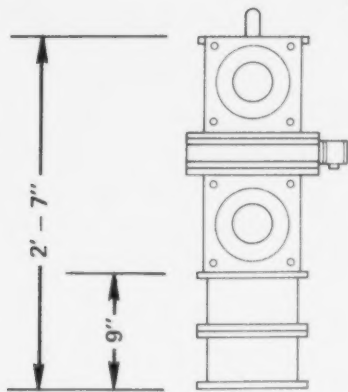


(c) Vertical--ELG-500/04

Figure 7-32. Horizontal and vertical directivity patterns for the ELG-500/02 and ELG-500/04 emitters.

Data Sheet 7-D(4). (cont'd).

ELG-500/02



ELG-500/04

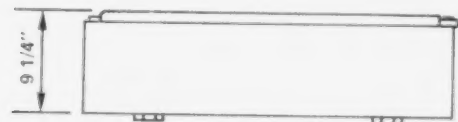
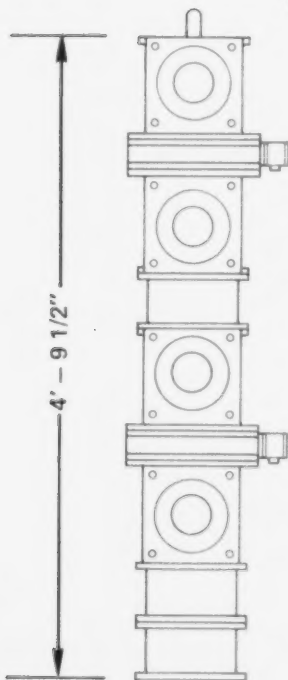


Figure 7-34. Dimensions of the CG-300 power supply cabinet.

Manufacturer

Automatic Power, Inc.
P.O. Box 18738
Houston, Texas 77023

Figure 7-33. Arrangement and dimensions for the 500-Hz directional emitters.

Data Sheet 7-D(4). (cont')

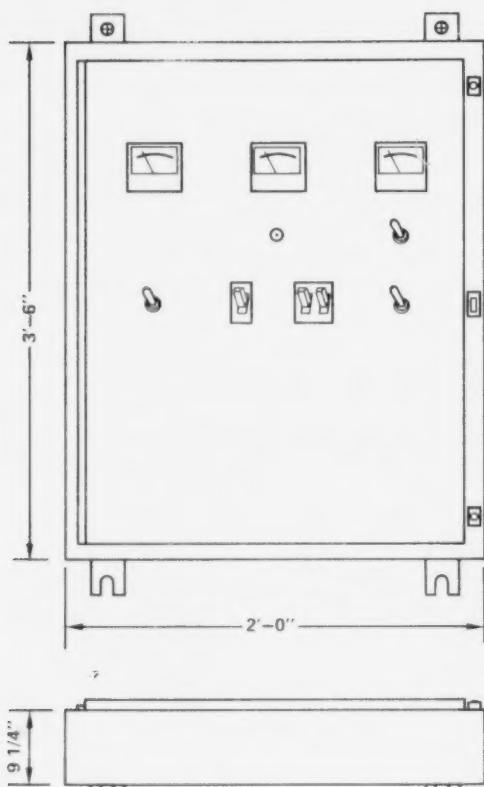
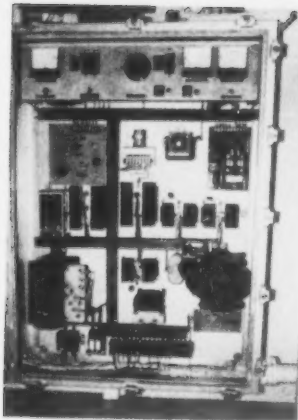
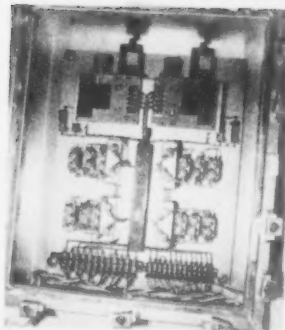


Figure 7-35. Dimensions of the SCR-300 power supply cabinet.

SCR-600-CG, ELU-500/08



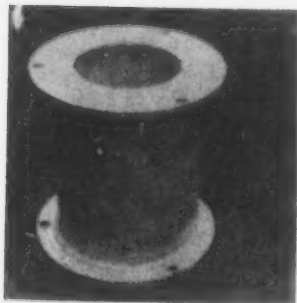
SCR-600-CG
Power Supply



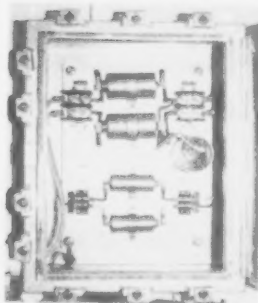
Current Monitor
& Power Factor
Corrector



ELU-500/08



Spacer



RFI Filter

Function. The SCR-600-CG power supply, the ELU-500/08 emitter, and associated equipment are used as the sound signal system for the large navigational buoy (LNB). This system has a maximum usual range of 3 nmi.

Physical Characteristics

- Omnidirectional
- Variable range
- Battery operated (24 Vdc)
- Corrosion resistant
- Waterproof
- Operates with any standard Coast Guard characteristics

Data Sheet 7-D(5). SCR-600-CG, ELU-500/08 sound signal system.

Electrical, Acoustical, and Mechanical Characteristics

	Two SCR-600-CG's, ELU-500/08
Voltage source	24 Vdc
Current drain (average)	35 A
Current drain (peak)	35 A
Battery charger (input voltage)	120 Vac
Battery charger (input current)	5 A (each supply)
Battery charger (short circuit current)	43 A (each supply)
Emitter voltage	350-400 Vac
Emitter current	7 A
Electrical frequency	250 Hz
Acoustical frequency	500 Hz
Acoustical level	139 dBC
Duty cycle	20% maximum
Emitter weight	400 lb
Power supply weight	330 lb
Radio frequency inter- face unit, cabinet weight	25 lb
Current monitor weight	38 lb

Input Power Requirements. Each SCR-600-CG power supply requires a 24-V battery for normal operation. A 120-Vac source is required for the battery charger, which maintains the batteries at 26.8 V. On the LNB, these 24-V batteries are also used in starting the diesel engine of the engine generator.

Output Level. The SCR-600-CG, ELU-500/08 signal is omnidirectional and shall NEVER be changed to directional. The output level of this signal can be reduced by means of the horn level control on the meter panel of the power supply. The lowest output level that this emitter can efficiently achieve is 128 dBC, at which the usual range is 1.5 nmi and the emitter current is 2.7 A. Figure 7-36 shows the functional relationship between the emitter current and the usual range of the signal.

LNB Installations. The ELU-500/08 emitter is made up of four ELU-500/02 emitters and four spacers. Its relative position on the LNB is as shown in Figure

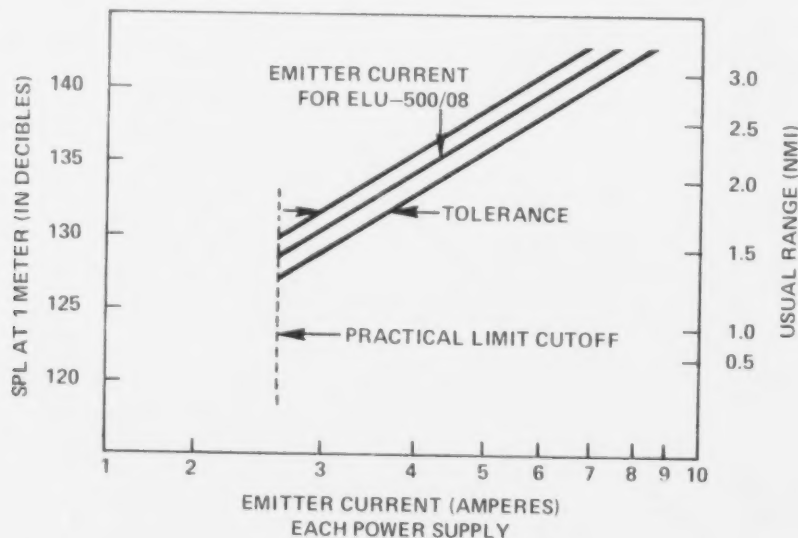


Figure 7-36. Input current and power to the emitter vs SPL for the ELU-500/08.

Data Sheet 7-D(5). (cont'd)

Electrical, Acoustical, and Mechanical Characteristics (cont'd)

7-37. The power supplies, RFI cabinets, and current monitor cabinets are located in the electronics compartment beneath the deck of the LNB.

Dimensions. Dimensions for the ELU-500/02 and ELU-500/08 emitters are shown in Figure 7-38. The power supply cabinet, power factor cabinet, and RFI filter cabinet dimensions are shown in Figures 7-39(a), (b), and (c).

Related Equipment. This is the only sound signal system that will fit directly onto the LNB without modification.

Additional Data. This signal has been purchased using Commandant (G-EOE) Purchase Description No. 203.

Manufacturer

Automatic Power, Inc.
P.O. Box 18738
Houston, Texas 77023

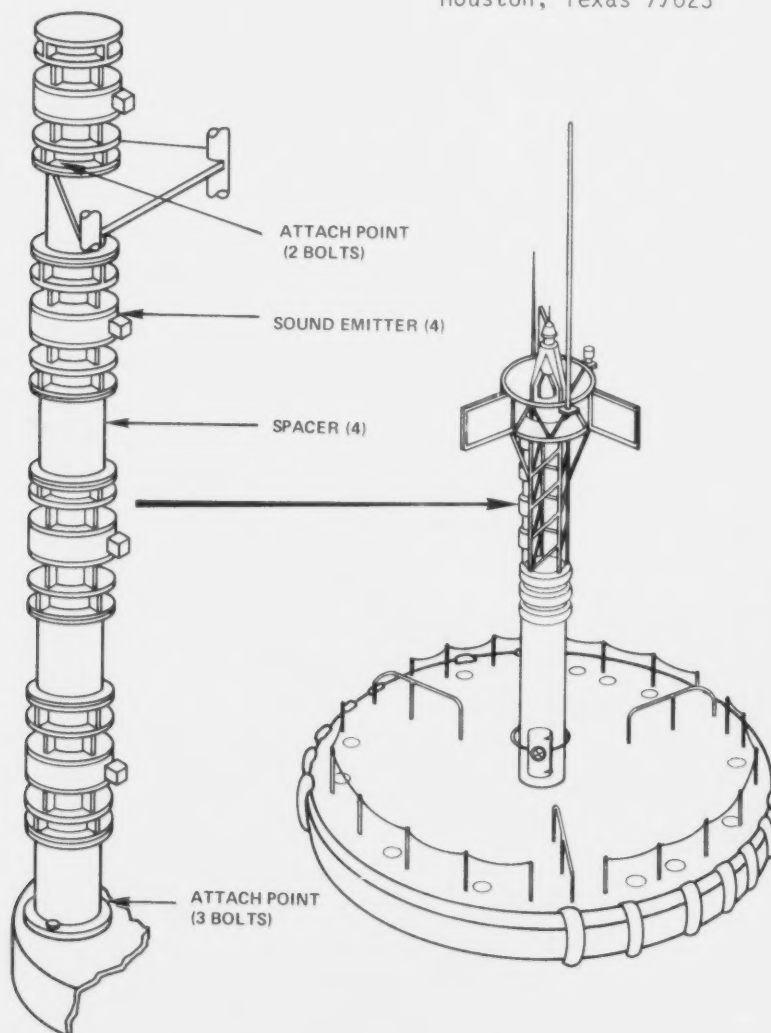


Figure 7-37. ELU-500/08 emitter and its location on the LNB.

Data Sheet 7-D(5). (cont'd).

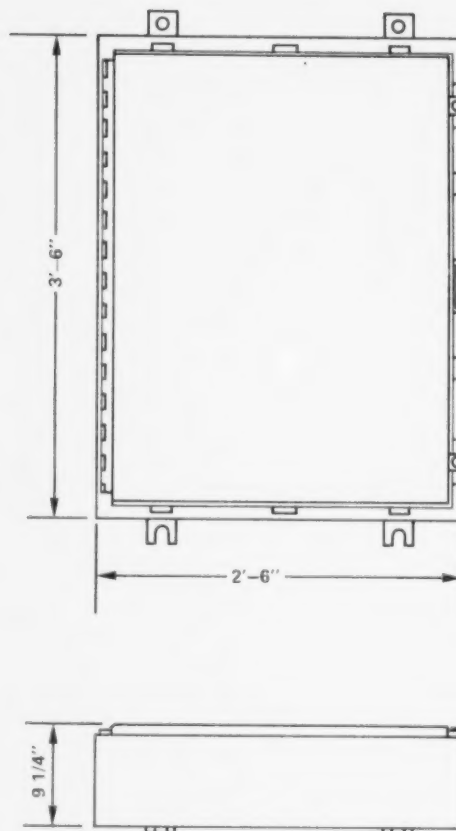
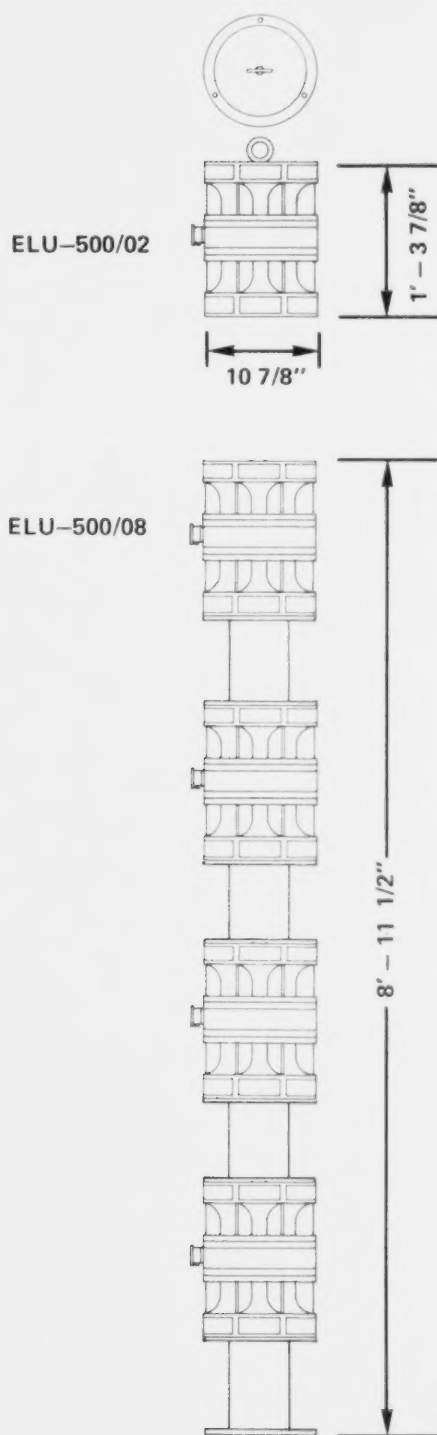


Figure 7-39(a). Dimensions of the SCR-600-CG power supply cabinet.

Figure 7-38. Arrangement and dimensions for the 500-Hz omnidirectional LNB emitters.

Data Sheet 7-D(5). (cont'd).

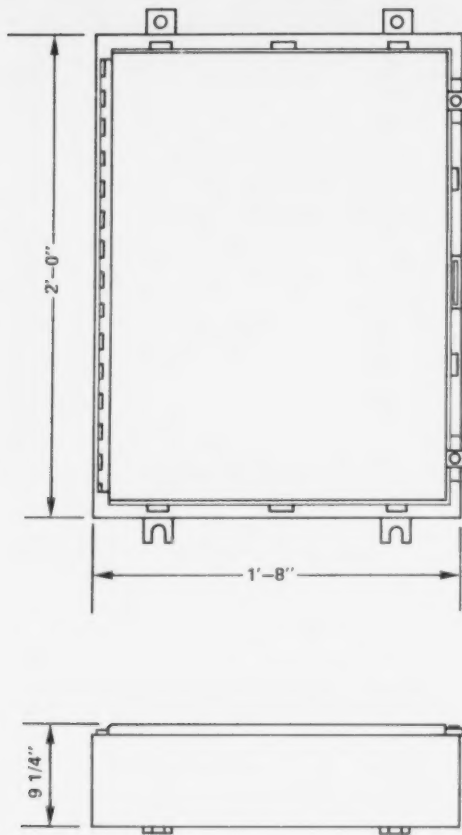


Figure 7-39(b). Dimensions of the power factor cabinet.

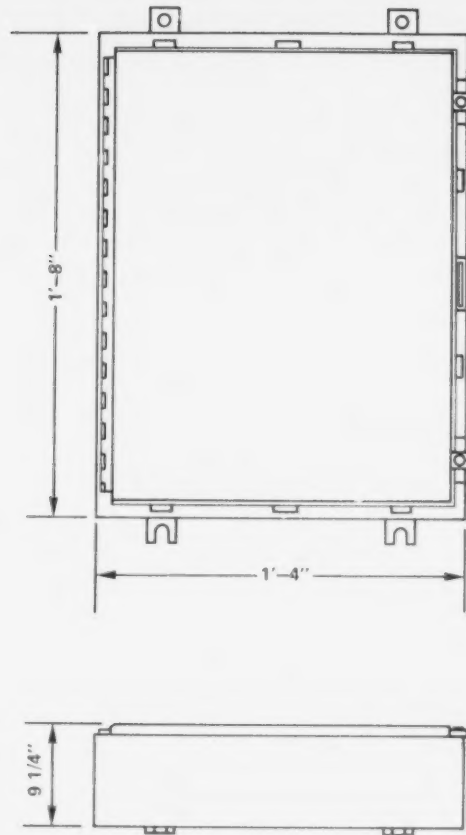
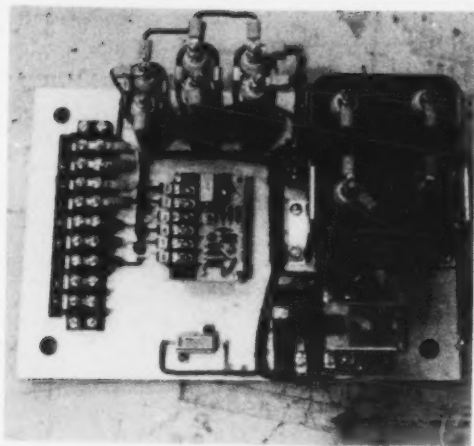


Figure 7-39(c). Dimensions of the RFI filter cabinet.

TEMPERATURE-CONTROLLED POWER FACTOR CORRECTOR



Function. The temperature-controlled power factor corrector is a device that will automatically switch in or out capacitance, as specified by the temperature. It shall be used if the ambient temperature falls below 20 degrees Fahrenheit for an extended period of time.

Physical Characteristics

- Temperature sensing
- Automatic switching
- Operates from either 12 Vdc or 24 Vdc

Dimensions. The dimensions for the temperature-controlled power factor corrector cabinet are shown in Figure 7-40.

Related Equipment. The temperature-controlled power factor corrector can be used with any of the following power supplies--CG-300, SCR-300, SCR-600-CG, CG-1000, and SCR-1000.

Manufacturer

Automatic Power, Inc.
P.O. Box 18738
Houston, Texas 77023

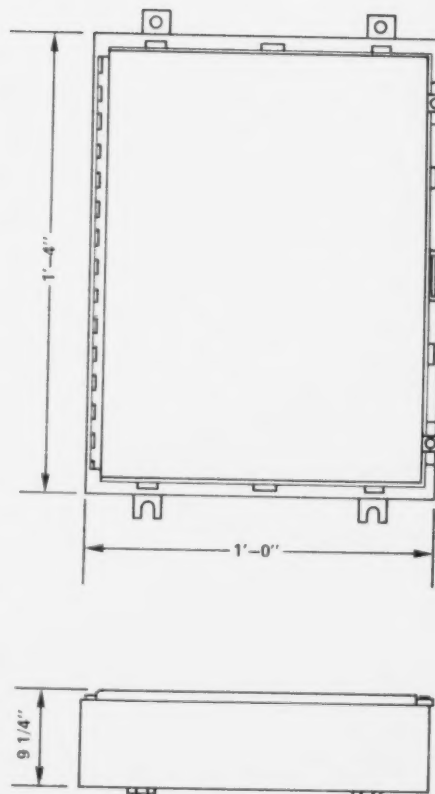
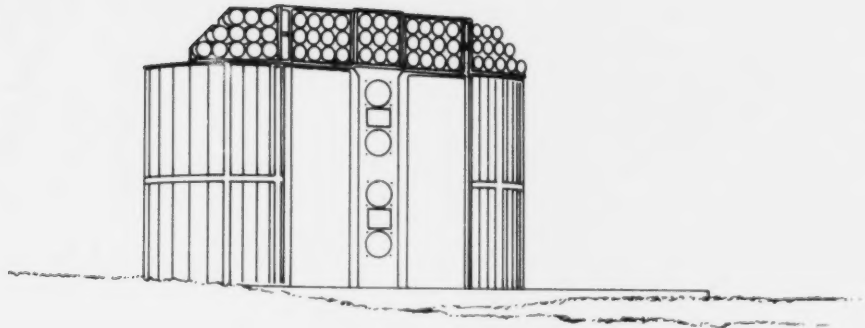


Figure 7-40. Weight and dimensions of the temperature-controlled power factor corrector cabinet.

Data Sheet 7-D(6). Temperature-controlled power factor corrector equipment.

STANDARD BAFFLE



Function. The baffle can be used to reduce the SPL on the back side of the signal. It can be used with any of the following pure-tone emitters--ELG-300/02, ELG-300/04, ELG-500/02, ELG-500/04, FA-232, or FA-232/02.

Where operational requirements permit, the baffle should be used as a noise control tool on existing structures or on new stations to be established or automated. In these situations, there would be either a history of noise complaints or an indication--through environmental assessment--of potential noise pollution.

Physical Characteristics

- o Directional
- o Minimal maintenance

Mechanical and Acoustical Characteristics. The approximate SPL reduction is 30 dB. This is shown by the directivity patterns for the baffles, as presented in Figures 7-41 through 7-46.

The physical construction of the baffle for the ELG-series emitters is reinforced concrete and steel. The physical construction of the baffle for the FA-232 is steel. All baffles are built on a reinforced concrete slab. This particular design for each of the baffles permits a wind loading velocity of 120 mi/hr.

Dimensions. Baffle dimensions for the six pure-tone emitters are shown in Figures 7-41 through 7-46.

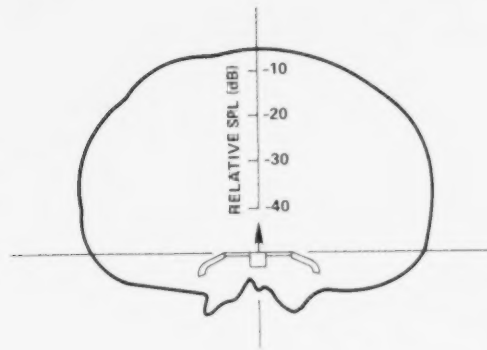
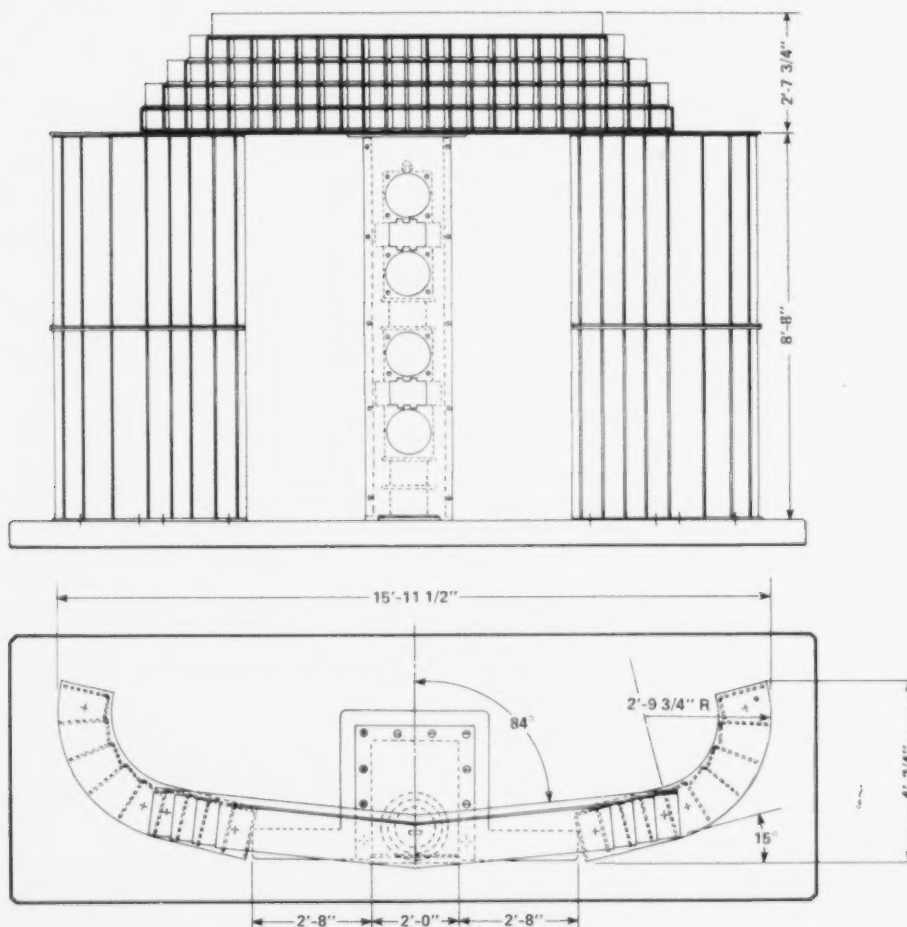


Figure 7-41(a). Directivity pattern for the standard baffle--broad pattern.*



*C. I. Malme, *Development of Improved Baffle Systems for Directional Fog Signals*, Contract No. DOT-CG-30200-A (U.S. Coast Guard, February 1975).

Figure 7-41(b). Assembly drawing of the standard baffle (broad pattern) for the ELG-300/04 emitter (Commandant (G-EOE) Drawing No. 130105-1, sheet #1).

Data Sheet 7-D(7). (cont'd).

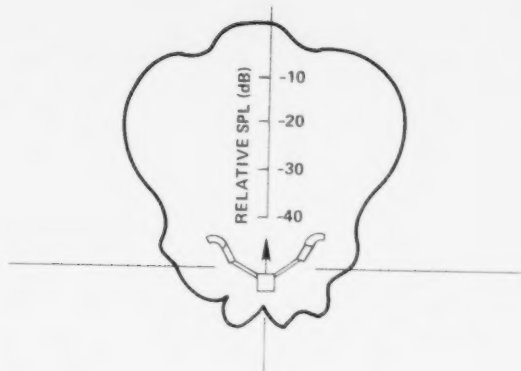
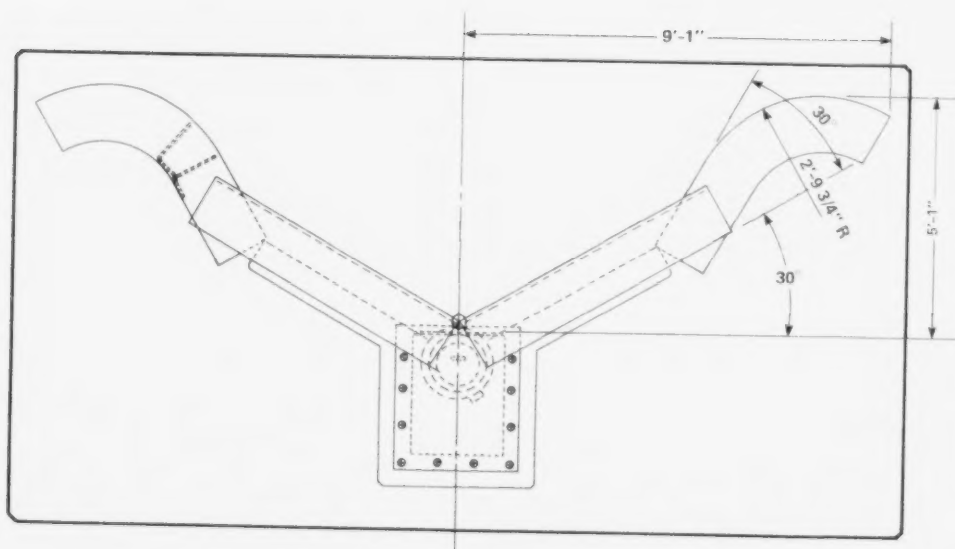


Figure 7-42(a). Directivity pattern for the standard baffle--narrow pattern.*



*C. I. Malme, *Development of Improved Baffle Systems for Directional Fog Signals*, Contract No. DOT-CG-30200-A (U.S. Coast Guard, February 1975).

Figure 7-42(b). Plan view drawing of the standard baffle (narrow pattern) for the ELG-300/04 emitter (Commandant (G-EOE) Drawing No. 130105-1, sheet #5).

Data Sheet 7-D(7). (cont'd)

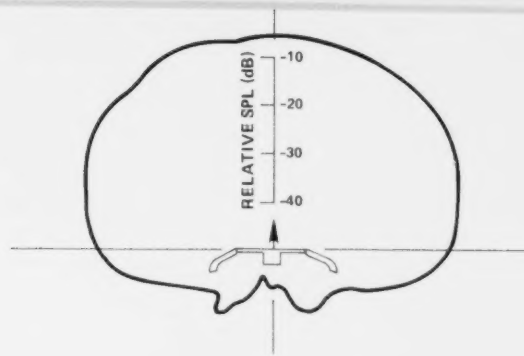
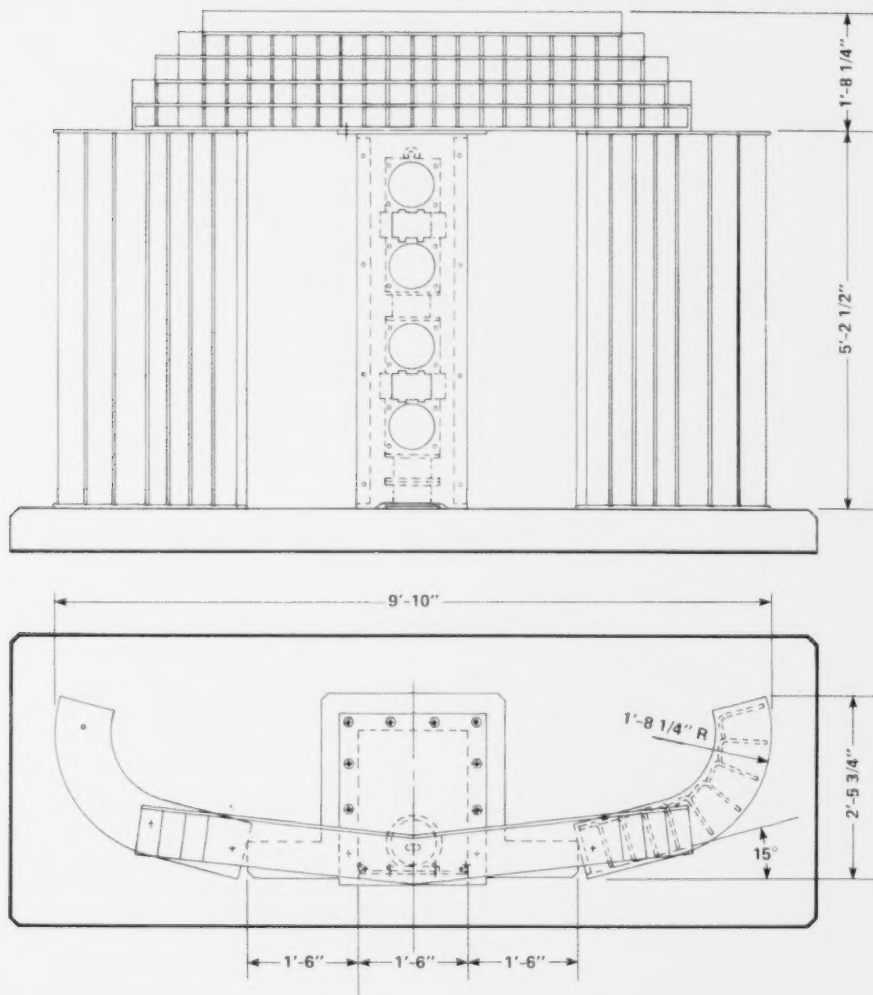


Figure 7-43(a). Directivity pattern for the standard baffle--broad pattern.*



*C. I. Malme, *Development of Improved Baffle Systems for Directional Fog Signals*, Contract No. DOT-CG-30200-A (U.S. Coast Guard, February 1975).

Figure 7-43(b). Assembly drawing of the standard baffle (broad pattern) for the ELG-500/04 emitter (Commandant (G-EOE) Drawing No. 130105-2, sheet #1).

Data Sheet 7-D(7). (cont'd).

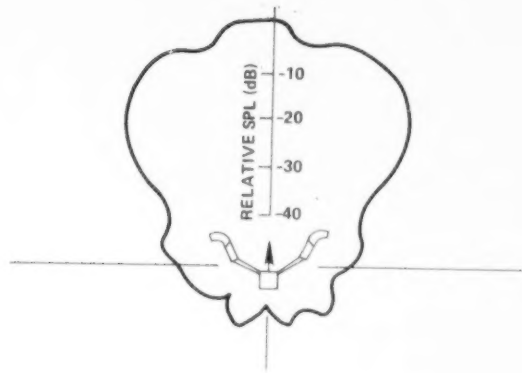
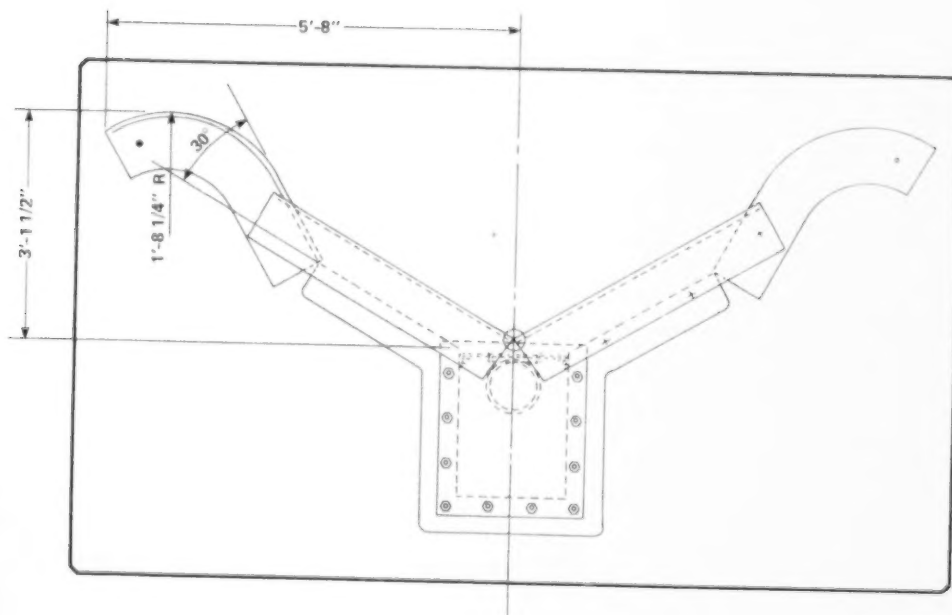


Figure 7-44(a). Directivity pattern for the standard baffle--narrow pattern.*



*C. I. Malme, *Development of Improved Baffle Systems for Directional Fog Signals*, Contract No. DOT-CG-30200-A (U.S. Coast Guard, February 1975).

Figure 7-44(b). Plan view drawing of the standard baffle (narrow pattern) for the ELG-500/04 emitter (Commandant (G-EOE) Drawing No. 130105-2, sheet #5).

Data Sheet 7-D(7). (cont'd)

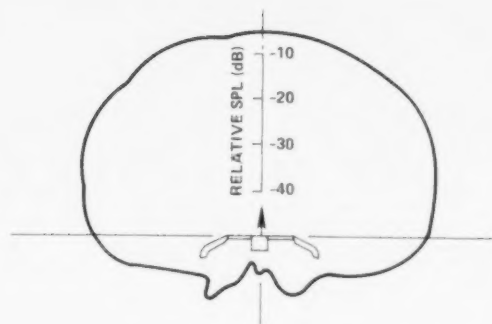
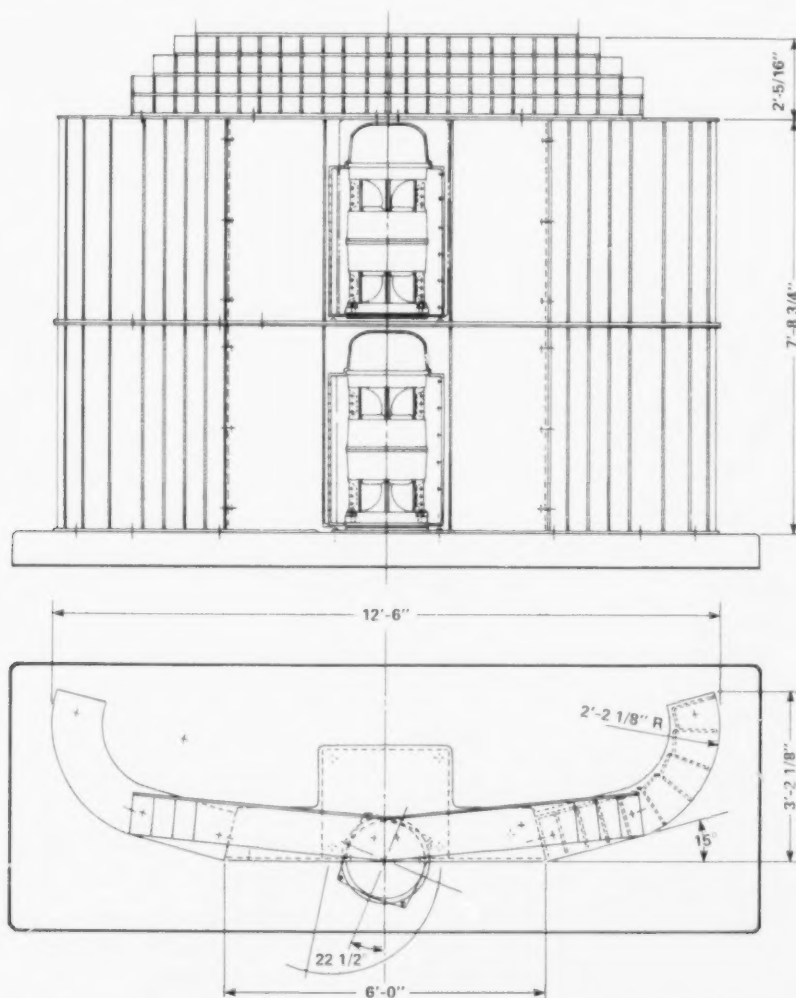


Figure 7-45(a). Directivity pattern for the standard baffle--broad pattern.*



*C. I. Malme, *Development of Improved Baffle Systems for Directional Fog Signals*, Contract No. DOT-CG-30200-A (U.S. Coast Guard, February 1975).

Figure 7-45(b). Assembly drawing of the standard baffle (broad pattern) for the FA-232 emitter (Commandant (G-EOE) Drawing No. 130105-3, sheet #1).

Data Sheet 7-D(7). (cont'd).

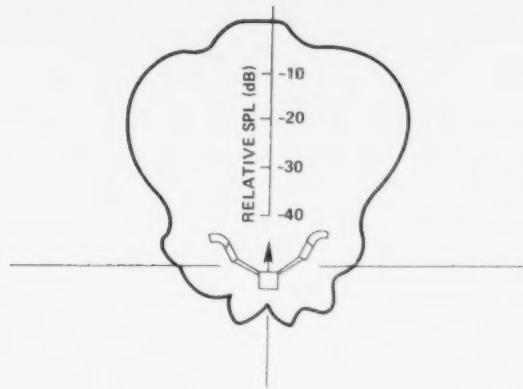
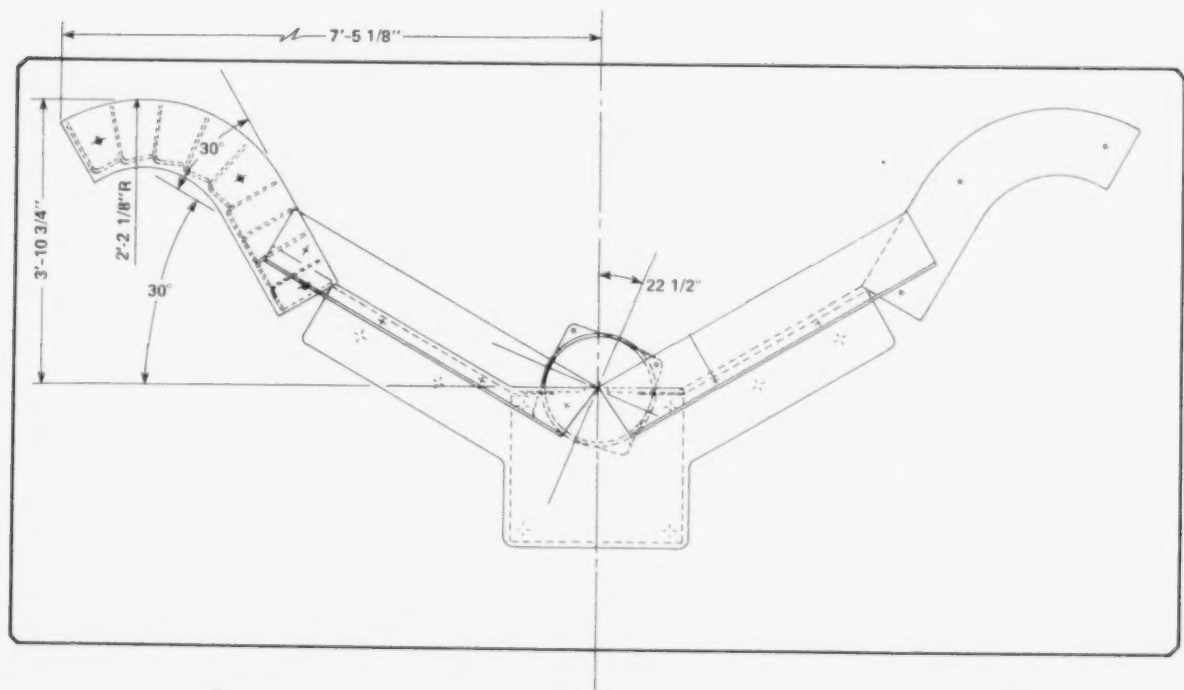


Figure 7-46(a). Directivity pattern for the standard baffle--narrow pattern.*



*C. I. Malme, *Development of Improved Baffle Systems for Directional Fog Signals*, Contract No. DOT-CG-30200-A (U.S. Coast Guard, February 1975).

Figure 7-46(b). Plan view drawing of the standard baffle (narrow pattern) for the FA-232 emitter (Commandant (G-EOE) Drawing No. 130105-3, sheet #5).

Data Sheet 7-D(7). (cont'd).

CHAPTER 8

MONITOR AND CONTROL EQUIPMENT

This chapter provides guidance for selection, inspection, maintenance, and repair of the monitor and control equipment used at automated aids to navigation.*

Equipment that interfaces the monitor and control equipment with the aids is also discussed. Applicable policies, reference literature, and sources of supply are identified.

*Preparation and installation, as noted in section B, is described in Automation Technical Guidelines (CG-250-41 series).

A. SELECTION GUIDE

Introduction. Selection of monitor and control equipment requires that the aid first be classified by the category selection process of *Automation Technical Guidelines* (CG-250-41 series). Using the appropriate category, enter Table 8-1 to determine the required and optional monitor and control equipment for the aid.

Category II Equipment. With Category II aids, and aid monitor system (AMS) and an aid control system (ACS) should be considered for use where no RCMS exists or is planned. Consult with Commandant (G-EOE) for design of AMS/ACS configurations.

Communication Equipment Options. Point-to-point communications for automated aids to navigation can be provided by radio, landline, cable, and microwave, or a combination of these. Selecting the most effective and efficient communication system requires that both administrative and engineering issues be resolved. The *Telecommunication Manual* (M2000.3) establishes communication planning guidelines and *Automation Technical Guidelines* (CG-250-41 series) provides engineering guidelines.

Table 8-1
Selection Guide for Required and Optional Monitor and Control Equipment

Equipment*		Equipment Category					
		I	II**	III	IV	V	VI
RCMS	MTU CDHU-6706-MV	R	R				
	CDHU-6706 RTU CDHU-6706-R	R	R				
Radio Link Set, Master Station CG-MSTR-202		O	O				
Radio Link Set, Remote Station CG-REM-202		O	O				
Aid Monitor System			R				
Aid Control System			O	O	O	O	
Audio-Visual Controller GCF-RWL-2098		R	R	R	R		
NAVAID Sensor Module GCF-RWL-2076		R	R	R	R		
NAVAID Sensor Module Panel GCF-RWL-2241			R	R			
Videograph B Fog Detector CDNC-147.122/222		O	O	O	O		
AC Flash Controller GCF-RWL-2106					O		

NO MONITOR OR CONTROL EQUIPMENT

*R = required, O = optional.

**Column 1, with RCMS; column 2 without RCMS.

B. PREPARATION AND INSTALLATION

The preparation and installation of monitor and control equipment is described in *Automation Technical Guidelines* (CG-250-41 series).

C. INSPECTION, MAINTENANCE, AND REPAIR

Inspection and Maintenance

Inspection Intervals and Maintenance

Checks. Maintenance checks shall conducted at the intervals indicated in Tables 8-2 and 8-3.

Standards. Procedures for conducting these maintenance checks are covered in the particular equipment technical manuals, and on Commandant (G-EOE) Standard Troubleshooting Drawings. Also, additional information explaining proper system operation is contained in CG-250-41 series publications. No standards, such as acceptable voltage limits, are listed in this section. Standards are listed in the technical manuals.

Test Equipment. Test equipment required for servicing monitor and control equipment is listed in Table 8-4. Consult Electronics Manual (CG-165) policy concerning acquisition of electronic test equipment not provided by Commandant (G-EOE) with the initial equipment issue.

Repair. Repair of the following monitor and control equipment shall conform with the policies specified in the Aids to Navigation Automation and Monitor Equipment chapter of the *Electronics Manual--Maintenance* (CG-165-2):

- a. remote control and monitor system
- b. radio link sets
- c. NAVAID sensor module and panel
- d. Videograph B fog detector
- e. Audio-Visual Controller
- f. AC Flash Controller

Repair, operational failure, removal, and similar events associated with monitor control equipment are to be reported as required by current directives. EICAM and SANDS are the reporting systems for the above-listed items of equipment.

Table 8-2
Monitor and Control Equipment Maintenance Checks and Inspection Intervals

Maintenance Check	EQUIPMENT			
	RCMS-MTU CDHU-6706-MV	RCMS-RTU CDHU-6706-R	Radio Link Set Master Station CG-MSTR-202	Radio Link Set Master Station CG-REM-202
KEY: A = annually SA = semiannually Q = quarterly M = monthly * = at every visit				
Frayed, loose, or defective wiring; terminations tight; mounting and hardware secure	A	SA	A	SA
FSK tone transmitting frequency and level adjustment	SA	SA		
FSK tone receiver bias and sensitivity adjustment	SA	SA		
LOW phone audio adjust and test	SA	SA		
Command status display panel check	M			
Transmitter status display, master monitor interface unit check (only applicable to RCMS-MTU's with relay transmitter sites)	M			
Relay transmitting reset, master monitor interface unit check (only applicable to RCMS-MTU's with relay transmitter sites)	M			
Low-pass filter, master monitor interface unit check	SA			
Primary/secondary transmitter input level, deviation, frequency, power, VSWR adjustment			SA	SA
Transfer panel power alarm control adjustment and switching on transfer			SA	SA
Dual receiver sensitivity quieting, modulation acceptance bandwidth, audio distortion, squelch sensitivity adjustments			SA	SA
Receiver volume				SA

Table 8-3
Monitor and Control Equipment Maintenance Checks and Inspection Intervals

KEY: A = annually
SA = semiannually
Q = quarterly
M = monthly
* = at every visit

Maintenance Check

	EQUIPMENT				
	Audio-Visual Controller GCF-RWL-2098	NAVAID Sensor Module GCF-RWL-2076	NAVAID Sensor Module Panel GCF-RWL-2241	Videograph B Fog Detector CDNC-147.122/222	AC Flash Controller GCF-RWL-2106
Frayed, loose, or defective wiring or components	SA		SA	SA	SA
Relays secure, terminations tight	SA			A	A
Barrier strip terminations tight, hardware secure	SA		A		A
CG-181, 1R1, 1RY9 terminations tight	SA				A
Bulkhead/floor mounting secure; conduits to/from enclosures secure, wires not chafing	SA			SA	SA
Enclosure damage, gasket intact (undamaged)	A		SA		SA
Emergency sound signal transfer and monitor check	Q	Q			
Emergency light transfer and monitor check	Q	Q			
Lampchanger(s)	Q				
Current sensitive relay, 1RY9, operation check	Q				
Current sensitive relay, 1RY9, calibration	SA				
Automatic reset	SA				
30-min OFF delay timer	SA				
CG-181 shutoff check	SA				
Fog detector reset	Q				
Fog detector failure indicator	Q				
CG-181 characteristic check	Q*				
Printed circuit cards secure	SA	SA	SA		

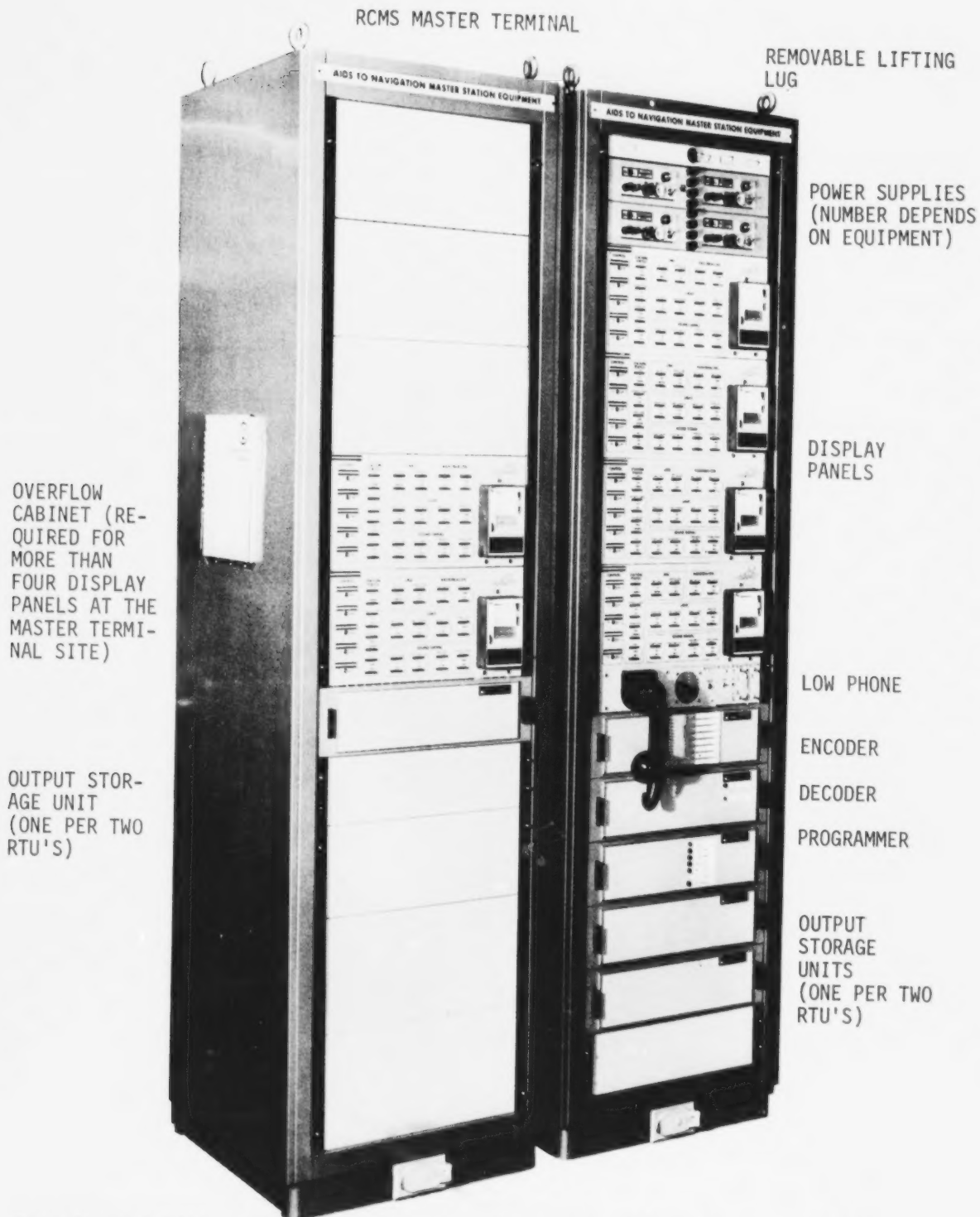
Table 8-3 (cont'd)

	EQUIPMENT				
	Audio-Visual Controller GCF-RWL-2098	NAVAID Sensor Module GCF-RWL-2076	NAVAID Sensor Module Panel GCF-RWL-2241	Videograph B Fog Detector CDNC-147.122/222	AC Flash Controller GCF-RWL-2106
Daylight control inspection					Chap. 6
Daylight control operational check					SA
Main circuit breaker ON/OFF check					SA
Projector lamp flashing				*	
Exterior of receiver and projector windows free of dirt, frost, and moisture				*	
State of failure indicator on test panel or AVC	*				
Supply voltage				SA	
Electrical zero				SA	
Light guide operation				SA	
Visibility alarm function				SA	
Perform fail-safe test				SA	
Replace flash lamp				4 1/2 yr	

Table 8-4
Test Equipment for Monitor and Control Equipment

Test Equipment		Monitor and Control Equipment							
Name	Description	G-EOE Provided with Initial Equipment Issue	RCMS	Radio Link Set	Audio-Visual Controller	NAVAID Sensor Module	NAVAID Sensor Module Panel	Videograph B Fog Detector	AC Flash Controller
Oscilloscope	1 mV/div, 50-MHz bandwidth		*			*		*	
Frequency counter	HP-5245L or equal		*	*					
Volt-ohmmeter	Triplet 630A or equal		*	*	*	*	*	*	*
Card extender	RFL HB-35545	*	*						
Card extender	Moore Systems, P/N 99900-011	*	*						
Carbon resistors (2 ea)	2700 ohm $\pm 5\%$, 1/2 W		*						
Thru-line watt-meter, 0-50 W, UHF	Bird model 43 or equal			*					
FM frequency generator	Measurements model 560 or equal			*					
FM deviation meter	Motorola S-1323A or equal			*					
Test set, GE	TM-11	*		*					
Mercury thermometer				*					
Clip-clip test lead					*				
Logic probe	Compatible with module logic					*			
Stopwatch or clock						*		*	
Pulse generator	GCF-RWL-2093	*						*	
Metric tool kit		*						*	

D. GENERAL DESCRIPTION DATA SHEETS



Data Sheet 8-D(1). Remote control and monitor system (RCMS) master terminal, CDHU-6706-MV.

Function. The aids to navigation monitor Equipment master terminal, CDHU-6706-MV, is the master terminal unit (MTU) of the remote control and monitor system (RCMS). The MTU is located at a shore site with a 24-hour watch and automatically interrogates each remote terminal unit (RTU) every 5 min and receives status information. It then displays the status of lights, sound signals, radiobeacons, power sources, and support systems. Selected aid functions can be controlled from the MTU. Voice communications with the RTU's can be conducted between automatic interrogations.

Features.

- Assembled and wired in NEMA-1 cabinets
- Monitors and controls up to eight RTU's
- Overflow cabinet required for configurations of more than four RTU's
- Display panel features (one panel per RTU) 32 status indications and five control functions
- Failure indications displayed by flashing visual alarm together with audible alarm
- Manual interrogation capability

Electrical Characteristics

Input 115 Vac, $\pm 10\%$, 60 Hz, 1 ϕ

Power consumption (display panels) 1 - 165 W; 2-275 W; 3-385 W; 4-495 W; 5-605 W; 6-715 W; 7-825 W; 8-935 W

Temperature -20°C to +70°C

Humidity up to 95% if there is no condensation

Contacts provided for external alarm control connections are rated at 2 A, 500 V, 100 VA maximum.

Dimensions and Weight

	H*	Dimensions W	D**	Maximum Weight (lb)
Master cabinet	7'-3 1/4"	1'-11 1/4"	1'-11"	401
Overflow cabinet	7'-3 1/4"	1'-11 1/4"	1'-11"	311

*Removable lifting lugs add 2 1/2 in. to the height.

**An additional 1 ft-11 in. is required to allow full opening of the cabinet back door.

Data Sheet 8-D(1). (cont'd).

Related Equipment. The items listed below are supplied with the master terminal (and display panels) in the quantities shown:

- one overflow cabinet with display panels and output (if required)
- one extender card, part no. 99900-011
- one RFL extender card, HB-29780
- two manufacturer's technical manuals

Other items required but not supplied, excluding the remote terminal unit and its associated equipment, are listed below:

- a communications link, either the master station radio link set, CG-MSTR-202, and transmission lines, or a landline communications link
- master monitor interface unit if required

- for a remotely located master radio site
- 115 Vac continuous source.

Additional Data. The manufacturer of the CDHU-6706-MV is Moore Systems Inc., 1730 Technology Drive, San Jose, California 95110. The *Technical Manual for CDHU-6706 Aids to Navigation Equipment (RCMS)* is issued with the equipment. Additional copies are available from SUPCEN stock; refer to CG-165-1 for ordering information.

The RCMS MTU is provided by the Commandant (G-EOE). Specific information is supplied as an endorsement to the applicable ELECTRONALT. A detailed maintenance support outline (MSO) is available for the RCMS and may be requested from Commandant (G-EOE).

RCMS REMOTE TERMINAL



Data Sheet 8-D(2). Remote control and monitor system (RCMS) remote terminal, CDHU-6706-R.

Function. The aids to navigation monitor equipment remote terminal, CDHU-6706-R, is the remote terminal unit (RTU) for the remote control and monitor system (RCMS). The RTU is located at the remote aid site where it receives status information from light, sound, radiobeacon, and support systems. It transmits all status information to a master terminal unit (MTU) in response to automatic interrogations from the MTU every 5 minutes. Selected aid functions can be controlled based on operator commands from the MTU. Voice Communications can be conducted between the automatic interrogations.

Dimensions and Weight

	H*	Dimensions W
RTU cabinet	5'-9 3/4"	1'-11 1/4"

Related Equipment. The RTU is supplied completely assembled. Extender cards and technical literature are supplied with the MTU. The following items, excluding the MTU and its associated equipment, are required but not supplied:

- a communications link, either the remote station radio link set, CG-REM-202, and transmission lines, or a landline communication link
- 12.6 Vdc, continuous power source audio-visual controller, GCF-RWL-2098, to act as the control interface between the RTU and the aids
- NAVAID sensor modules, GCF-RWL-1854 or 2076 (with associated wiring harness), to act as the sensor interface between the RTU and the aids.

Features

- Assembled and wired in NEMA-1 cabinets
- Monitors and transmits up to 15 aid functions (30 status indications)
- Controls up to five aid functions
- Normally requires no special environment other than an inside location

Electrical Characteristics

Input	+12.6 Vdc supply
Power consumption	11 W
Temperature	-40°C to +75°C
Humidity up to 95% if there is no condensation	

D**	Maximum Weight (lb)
-----	------------------------

1'-11 7/8"	304
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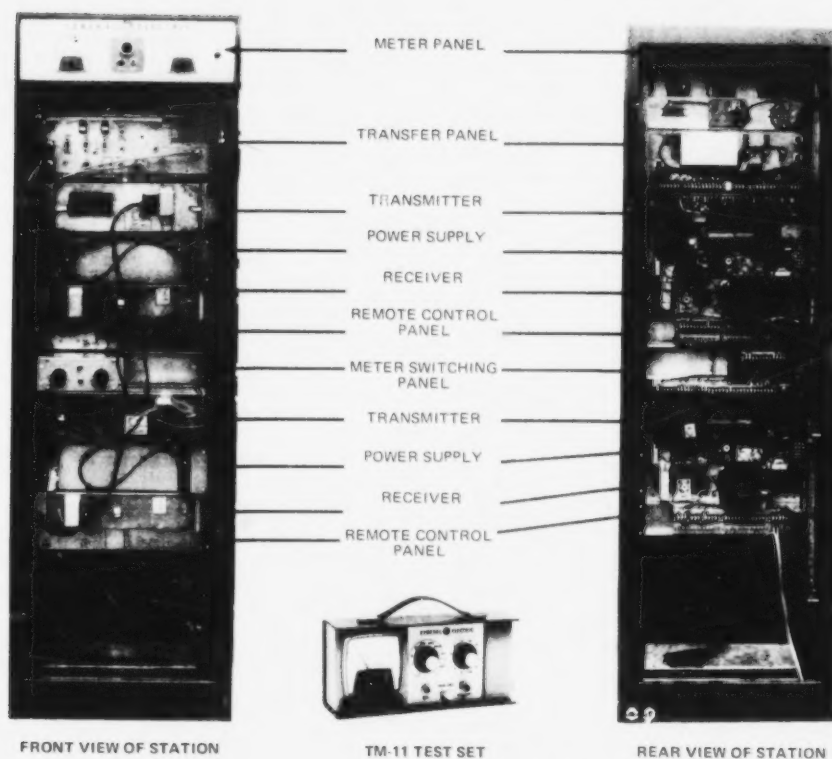
Additional Data. Moore Systems Inc., 1730 Technology Drive, San Jose, California 95110, is the manufacturer of the CDHU-6706-R. As listed on Data Sheet 8-D(1), the *Technical Manual for CDHU-6706 Aids to Navigation Equipment (RCMS)* is issued with the equipment. Additional copies are available from SUPCEN stock; refer to CG-165-1 for ordering information.

The RCMS RTU is provided by the Commandant (G-EOE). Specific information is supplied as an endorsement to the applicable ELECTRONALT. A detailed maintenance support outline (MSO) is available for the RCMS and may be requested from Commandant (G-EOE).

* Removable lifting lugs add 2 1/2 in. to height.

** An additional 1 ft-11 in. is required, both front and back, to allow full opening of the cabinet doors.

MASTER STATION RADIO LINK SET



Function. The master station radio link set, CG-MSTR-202, is a radio station used with the aids to navigation monitor equipment master terminal, CDHU-6706-MV. The master and associated remote radios provide communication links between the master and remote terminals of the remote control and monitor system (RCMS).

Features

- Assembled and wired in metal cabinets
- Primary and secondary transmitters
- Automatic transfer from primary to secondary transmitter
- Dual receivers for reliability
- Power, keying, and transmitter status indicator lamps
- Secondary transmitter audible and visual alarm with silence switch
- Built-in tuning meters and test switches
- 406- to 420-MHz band

Data Sheet 8-D(3). Master station radio link set, CG-MSTR-202.

Electrical Characteristics

Station

Input 115 Vac, $\pm 10\%$, 50 to 60 Hz
Power consumption 2.4 A (maximum), 220 W
Temperature -30°C to $+60^{\circ}\text{C}$

Transmitter

RF power 30 W (minimum) at system output
Audio response 300 to 3000 Hz

Receiver

Input and output impedance 600 ohms
Audio output 5 W at less than 5% distortion
Frequency response 300 to 3000 Hz

Dimensions and Weight

	H	Dimensions W	D*	Maximum Weight (lb)
CG-MSTR-202	5'-9"	1'-10"	1'-11"	424

Related Equipment. The items listed below are supplied with the master station radio link set in the quantities shown:

- two transmitters
- two receivers
- two power supplies
- two line amplifiers
- one transfer panel
- two remote control panels
- one meter panel
- one meter switching panel
- one microphone
- one speaker
- one RF cable assembly
- one cabinet
- one TM11 test set
- two manufacturer's technical manuals
- one spare radio set

Other equipment required but not supplied --excluding the RCMS and its associated equipment--is listed below:

- transmission lines and antenna
- master radio interface unit if required for a remotely located master radio site
- 115 Vac continuous

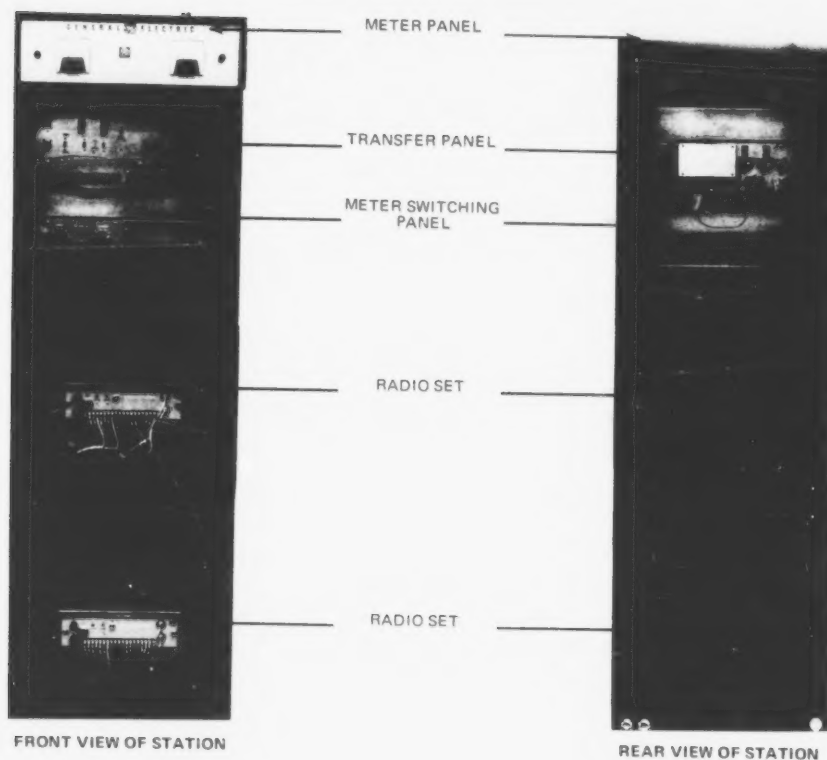
Additional Data. The manufacturer of the master station radio link set is the Mobile Radio Department of the General Electric Co., Lynchburg, Virginia 24502. Two copies of the *Maintenance Manual for Radio Link Set, MSTR LBI 9430* (applicable to CG-MSTR-202) or *LBI 9627* (applicable to CG-MSTR-202A) are issued with the equipment. Additional copies are available from SUPCEN stock; refer to CG-165-1 for ordering information.

* Additional 1 ft-11 in. is required, both front and back, to allow full opening of the cabinet doors.

Additional Data (cont'd)

The CG-MSTR-202 is provided by the Commandant (G-EOE). Specific information is supplied as an endorsement to the applicable ELECTRONALT. A detailed maintenance support outline (MSO) is available for the radio link set and may be requested from Commandant (G-EOE).

REMOTE STATION RADIO LINK SET



Function. The remote station radio link set, CG-REM-202, is a radio station used with the aids to navigation monitor equipment remote terminal, CDHU-6706-R. The remote radios and associated master radio provide communication links between the remote terminals and master terminal of the remote control and monitor system (RCMS).

Features

- Assembled and wired in metal cabinets
- Primary and secondary transmitters
- Automatic transfer from primary to secondary transmitter
- Dual receivers for reliability
- Power and keying indicator lamps
- Built-in tuning meters and test switches
- 406- to 420-MHz band
- Space to accommodate RCMS remote terminal equipment

Data Sheet 8-D(4). Remote station radio link set, CG-REM-202.

Electrical Characteristics

Station

Input 13.6 Vdc, $\pm 20\%$, negative ground
Power consumption 17 A (maximum), 220 W
Temperature -30° to $+60^{\circ}\text{C}$

Transmitter

RF power output 30 W (minimum) at system output
Audio response 300 to 3000 Hz

Receiver

Input and output impedance 600 ohms
Audio output 5 W at less than 5% distortion
Frequency response 300 to 3000 Hz

Dimensions and Weight

	H	Dimensions W	D*	Maximum Weight (lb)
CG-REM-202	5'-9"	1'-10"	1'-11"	363

Related Equipment. The following items are supplied with the remote station radio link set in the quantities shown:

- two transmitters
- two receivers
- two power supplies
- two control units
- one transfer panel
- two remote control boards
- one meter panel
- one meter switching panel
- one microphone
- one speaker
- one RF cable assembly
- one cabinet
- two manufacturer's technical manuals.

Excluding the RCMS and its associated equipment, the following are required but not supplied with the remote radio:

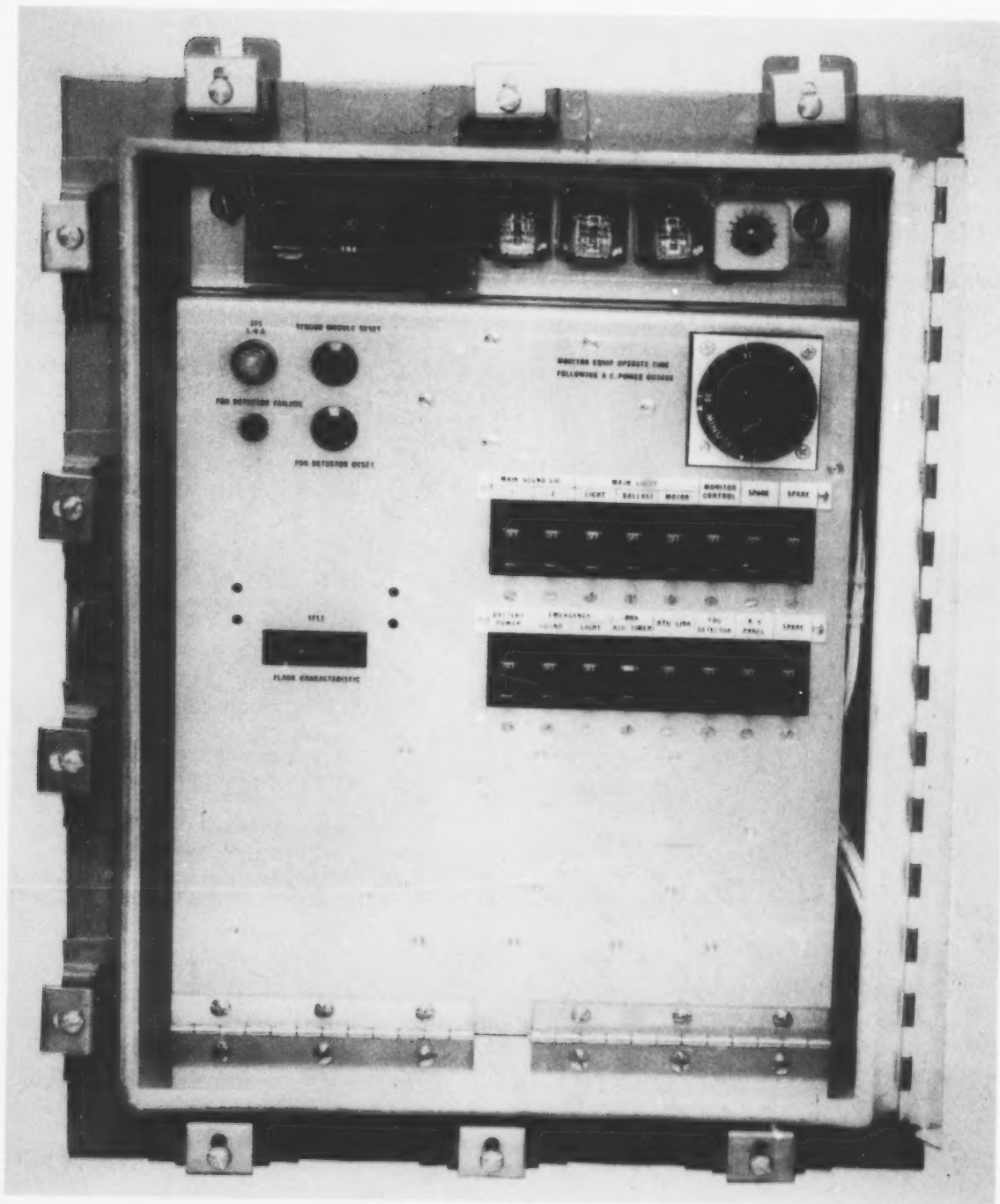
- transmission lines and antenna
- 13.6 Vdc source

Additional Data. The Mobile Radio Department of the General Electric Co., Lynchburg, Virginia 24502, is the manufacturer of the remote radio set. Two copies of the *Maintenance Manual for Radio Link Set REM STA LBI 9431* (applicable to CG-REM-202) or *LBI 9626* (applicable to CG-REM-202A) are issued with the equipment. Additional copies are available from SUPCEN stock; refer to CG-165-1 for ordering information.

The CG-REM-202 is provided by Commandant (G-EOE). Specific information is supplied as an endorsement to the applicable ELECTRONALT. A detailed maintenance support outline (MSO) is available for the radio link set and may be requested from Commandant (G-EOE).

* An additional 1 ft-11 in. is required, both front and back, to allow full opening of the cabinet doors.

AUDIO-VISUAL CONTROLLER



Data Sheet 8-D(5). Audio-visual controller, GCF-RWL-2098.

Function. The audio-visual controller (AVC), GCF-RWL-2098, is a combined power distribution panel and interfacing panel. It distributes both 120 Vac and 12 Vdc signal and control power, and provides circuit protection for all critical load circuits. It interfaces all light and sound signal operation detectors with the NAVAID sensor modules, and contains control relays to handle switching of higher power-level control circuits which cannot be handled directly by the NAVAID sensor module. The AVC also provides local manual reset functions for the NAVAID sensor module and fog detector.

Features

- Assembled and wired in a NEMA-4 enclosure
- Hinged front access door
- Front panel contains circuit breakers, reset switches, relays, and current detectors from main and emergency lights and emergency sound signal
- Front panel is hinged at the bottom for servicing and to expose the rear terminal panel
- Barrier strips on the terminal panel for all external connections
- Adjustable time delay for automatic removal of selected loads from the 12 Vdc bus after loss of 120 Vac
- Adjustable time delay to automatically reset system after loss and restoration of 120 Vac

Electrical Characteristics

Inputs	120 Vac, 60 Hz, 1 ϕ 12 Vdc, 50 A maximum		
Outputs	120 Vac	Main light	2000 W rotating 1000 W flashed (2000 W maximum capability)
		Sound signal	20 A circuit breaker provided for each power supply
	12 Vdc		emergency light emergency sound signal fog detector radiobeacon automatic switch unit/ timer

Dimensions and Weight

	H	Dimensions W D*		Maximum Weight (lb)
AVC, GCF-RWL-2098	1'-8"	1'-4"	10"	55

* An additional 1 ft-3 in. is required to allow full opening of the enclosure door.

Data Sheet 8-D(5). (cont'd).

Related Equipment. The AVC is supplied with all relays, switches, circuit breakers, and current detector printed circuit boards. Some additional assembly may be required to accommodate specific equipment arrangements. Items required with the audio-visual controller but not supplied, excluding the aids and any necessary monitor and control system, are listed below:

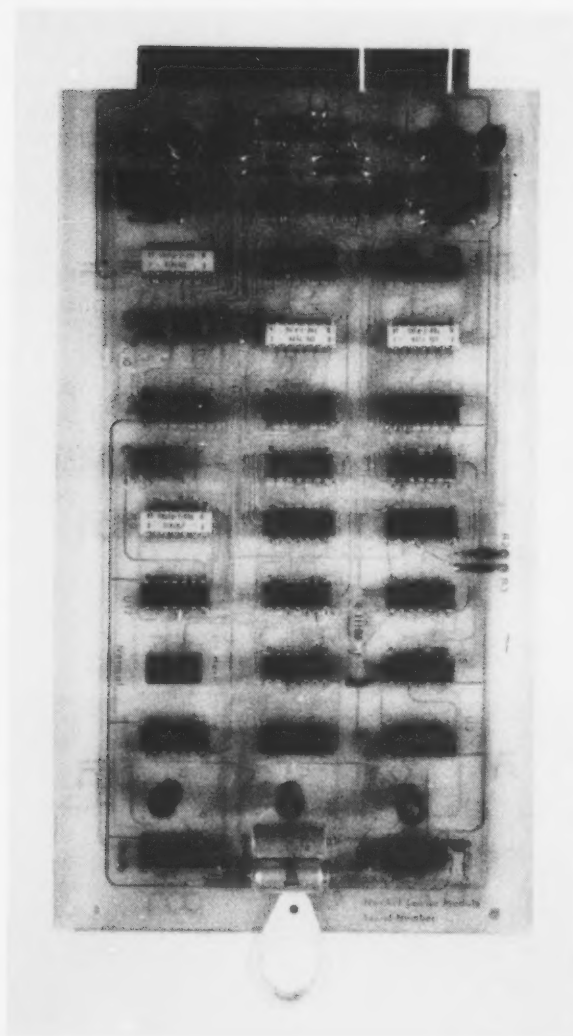
- NAVAID sensor modules for light and sound signal as applicable
- 120 Vac and 12 Vdc continuous sources
- current-sensitive relay, 1RY9, and a 25 A, 120 Vac circuit breaker if the main light is a 2000 W rotating beacon
- solid-state flasher, CG-181, with the proper characteristic if the main light is flashed.

Additional Data. Applications Technology Associates, Inc., 2743 Creek Hill Road,

Leola, Pennsylvania 17540; U.S. Coast Guard Base, Sault Ste. Marie, Michigan 49783; and U.S. Coast Guard Engineering Laboratory, U.S. Coast Guard Station, Alexandria, Virginia 22310, manufacture the audio-visual controller (codes AT, SS, and WR, respectively). The *Instruction Booklet for Audio-Visual Controller*, GCF-RWL-2098 and the *Technical Manual for NAVAID Sensor Module*, GCF-RWL-1854 and GCF-RWL-2076 are available from SUPCEN stock; refer to CG-165-1 for ordering information.

The ACV is provided by Commandant (G-EOE). Specific information is supplied as an endorsement to the applicable ELECTRONALT. A detailed maintenance support outline (MSO) is available for the AVC and may be requested from Commandant (G-EOE).

NAVAID SENSOR MODULE



Function. The NAVAID sensor module is the central processor for the light and sound signal status information. It senses improper main signal characteristics, controls the transfer from the main to emergency signals, and presents signal status information to remote terminal equipment. One card is required for light signal functions and another card is required for sound signal functions. There are two models--the GCF-RWL-1854 and the GCF-RWL-2076.

Features (both models)

- Glass-epoxy, keyed printed circuit boards
- Each sensing channel adjustable for signal characteristics (adjustment external to board for GCF-RWL-1854 and on the board for GCF-RWL-2076)
- Local manual, remote automatic, and remote commanded reset capabilities
- Command line function for use with fog detector

Data Sheet 8-D(6). NAVAID sensor module, GCF-RWL-2076.

Electrical Characteristics. Both models are constructed on G-10 glass-epoxy printed circuit boards.

GCF-RWL-1854	+5 Vdc and +12 Vdc
Voltage requirements	+5 Vdc and +12 Vdc
Operating power	less than 1.6 W

GCF-RWL-2076

Voltage requirements	+12 Vdc
Operating power	less than 2.1 W

Dimensions and Weight

	Dimensions	Weight (oz)
GCF-RWL-1854	4 3/4" X 9 1/2"	6.5
GCR-RWL-2076	4 3/4" X 9 1/2"	6.5

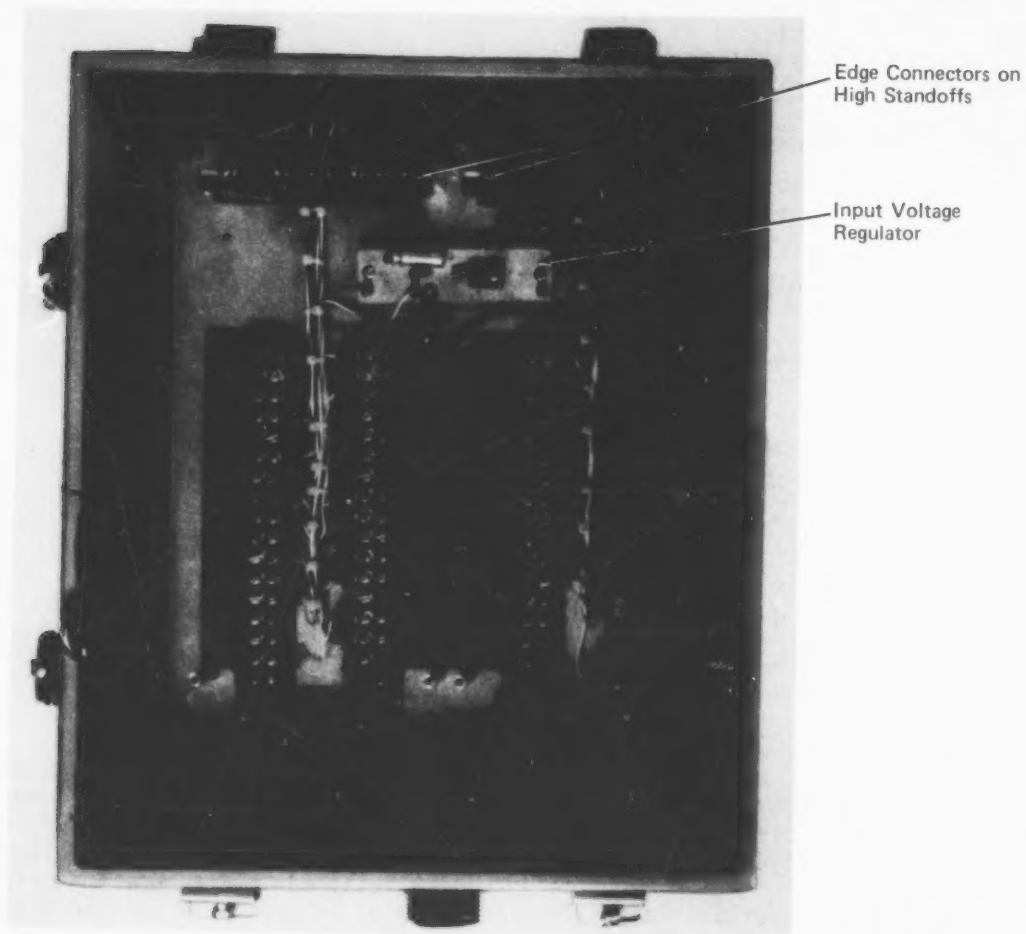
Related Equipment. The NAVAID sensor module is supplied complete and ready for installation after sensing channel timing settings are made. Only model GCF-RWL-2076 modules are currently issued. The following items are required for use with the NAVAID sensor module, but not supplied:

- wiring harness for use with the aids to navigation monitor equipment remote terminal, CDHU-6706-R
- NAVAID sensor module panel, GCF-RWL-2241, if modules are not installed in CDHU-6706-R
- GCF-RWL-2098 audio-visual controller.

Additional Data. Model GCF-RWL-1854 (which can only function with remote terminal unit, CDHU-6706-R) is being phased out and will no longer be issued. The *Technical Manual for NAVAID Sensor Module, GCF-RWL-1854 and GCF-RWL-2076* is available from SUPCEN stock; refer to CG-165-1 for ordering information.

The NAVAID sensor module and wiring harness are provided by Commandant (G-EOE). Specific information is supplied as an endorsement to the applicable ELECTRONALT. A detailed maintenance support outline (MSO) is available for the NAVAID sensor module and may be requested from Commandant (G-EOE).

NAVAID SENSOR MODULE PANEL



Function. The NAVAID sensor module panel, GCF-RWL-2241, is a cabinet that houses only the NAVAID sensor modules, GCF-RWL-2076. This cabinet is required at automated aids that have an emergency light or emergency sound signal and no remote control and monitor system (RCMS).

Features

- Assembled and wired in a NEMA-4 cabinet
- Edge connectors for two model GCF-RWL-

2076 NAVAID sensor modules (one for the light and one for the sound signal)

- Barrier strips for making connections to the audio-visual controller, aid control system, or aid monitor system
- 12 Vdc regulator assures stable input voltage to the NAVAID sensor modules
- Nylon stuffing tube for wire entry

Electrical Characteristics

Input	+12 Vdc
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Data Sheet 8-D(7). NAVAID sensor module panel, GCF-RWL-2241.

Dimensions and Weight

	H	Dimensions W	D	Maximum Weight (1b)
GCF-RWL-2241	1'-2"	1'	6"	15

Related Equipment. The NAVAID sensor module panel is supplied completely assembled. Items required but not supplied are listed below:

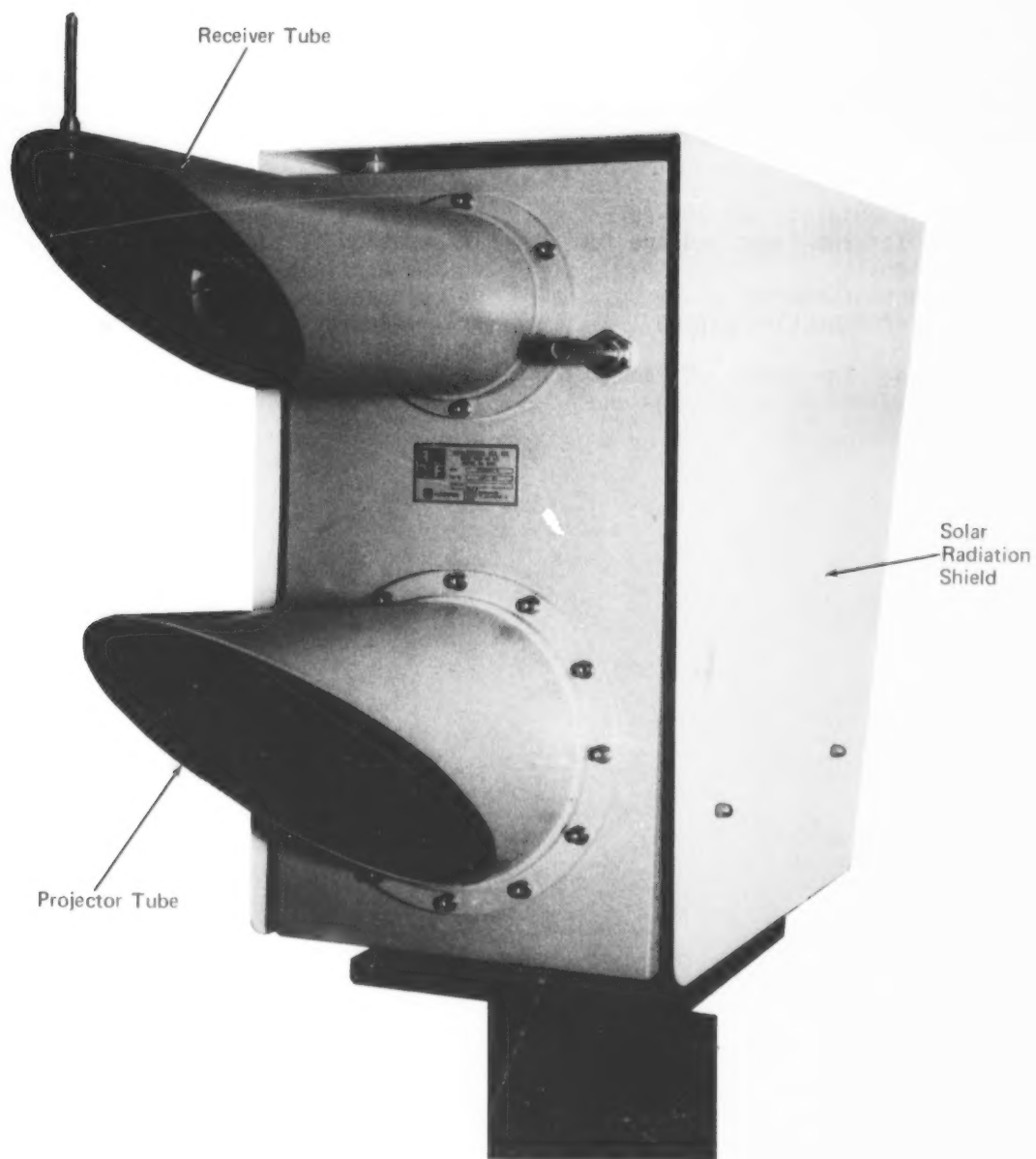
- NAVAID sensor modules, GCF-RWL-2076 (one module for the light and one for the sound signal)
- 12 Vdc continuous source
- external interconnecting wiring.

Additional Data. The *Technical Manual for NAVAID Sensor Module, GCF-RWL-1854* and

GCF-RWL-2076 is available from SUPCEN stock; refer to CG-165-1 for ordering information.

The NAVAID sensor module panel is provided by Commandant (G-EOE). Specific information is supplied as an endorsement to the applicable ELECTRONALT. A detailed maintenance support outline (MSO) is available for the NAVAID sensor module panel and may be requested from Commandant (G-EOE).

VIDEOGRAPH MODEL B FOG DETECTOR



Data Sheet 8-D(8). Videograph model B fog detector, CDNC-147.122/222.

Function. The Videograph model B fog detector, CDNC-147.122/222, is an automatic atmospheric visibility measuring instrument. It is used at automated aids to control the operation of sound signals by the receiver which detects light (from the projector) that is backscattered from fog, rain, snow, or air pollution.

Features

- Assembled and wired on a weatherproof aluminum housing
- Long-life Xenon projector flash lamp
- Replaceable receiver module
- Automatic interrogation (self-checking) with fail-safe
- Mounts on a fixed, level base or pedestal
- Thermostatically controlled heaters prevent mist and frost formation on windows and lens
- Shading tubes protect projector output and receiver input from stray light and weather
- Solar radiation shield

Dimensions and Weight

	H	Dimensions W	L	Maximum Weight with Base (lb)
Videograph B	2'-2 1/4"	1'-7/8"	3'-1 7/16"* 2'-2 5/8"**	106

Related Equipment. The fog detector is supplied completely assembled. Excluding the sound signal, the fog detector requires the following (which are not supplied):

- 11 to 14 Vdc continuous
- interfacing with the audio-visual controller, GCF-RWL-2098, when this controller is installed at a remote site.

Additional Data. The manufacturer of the Videograph B fog detector is the Electronics System Division of the Harris-Intertype Corp., Melbourne, Florida 32901.

- * Length at receiving shield.
**Length at projector shield.

Electrical Characteristics

General

Input	11 to 14 Vdc
Operating temperature	-30°C to +45°C
Window heater	normal thermostat setting +10°C

Projector

Power consumption	projector, 3.5 W window heater, 12 W
Lamp life expectancy	2 yr (minimum)

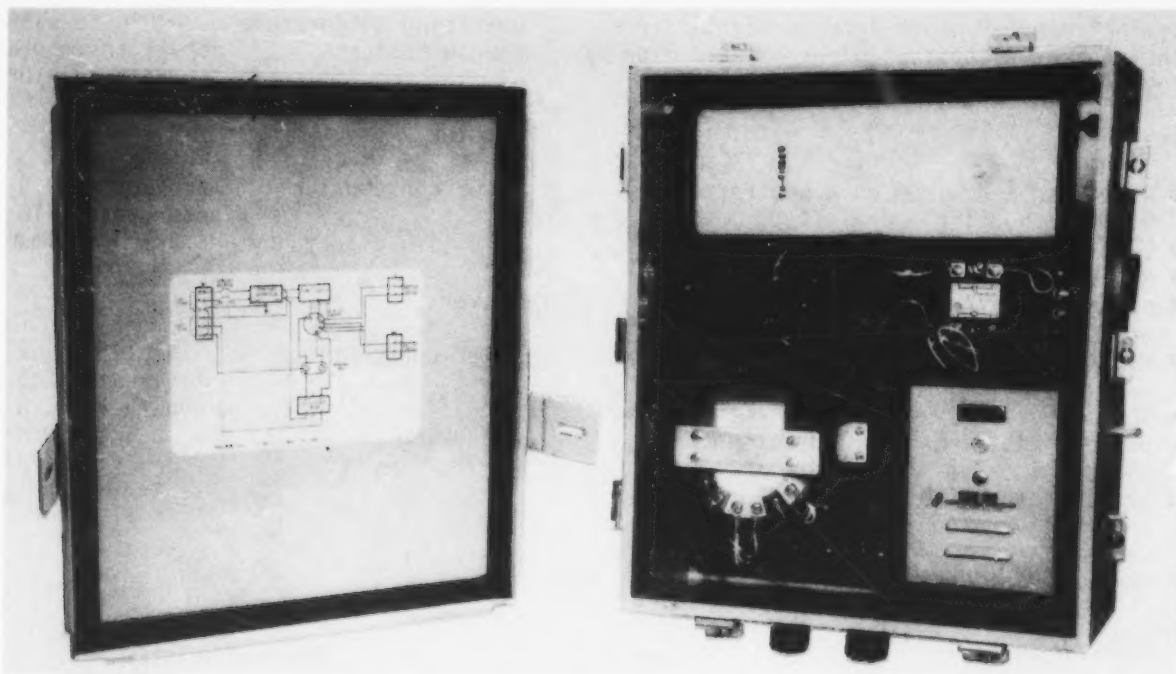
Receiver

Power consumption	amplifier, 2 W fail-safe, 2.5 W window heater, 4 W
Measuring range	0.1 to 10 nmi visibility

A manual, *Operation and Maintenance Instructions, Videograph Model B*, is issued with the equipment. Additional copies are available from SUPCEN stock; refer to CG-165-1 for ordering information.

The Videograph model B fog detector is provided by Commandant (G-EOE). Specific information is supplied as an endorsement to the applicable ELECTRONALT. A detailed maintenance support outline (MSO) is available for the fog detector and may be requested from Commandant (G-EOE).

AC FLASH CONTROLLER



Function. The AC flash controller, GCF-RWL-2106, is an integrated controller used to flash and daylight control 120 Vac incandescent lamps of up to 1000 W where there is no requirement for an emergency light. It also provides power line transient protection and circuit breaker protection for the lamp and internal control circuits.

Features

- Assembled and wired in a NEMA-4 enclosure

- Enclosure cover can be double padlocked
- Uses CG-181 solid-state flasher
- Terminals and receptacles for CG-234 type L daylight control
- Nylon stuffing tubes for wire entry

Electrical Characteristics

Input	120 Vac, 60 Hz 1 ϕ , 10 A
Output	120 Vac, 60 Hz 1 ϕ 10 A (maximum)
Internal	12 Vdc, 2 A (maximum) is available within the enclosure to power the CG-181 flasher.

Dimensions and Weight

	H	Dimensions W	D	Maximum Weight (lb)
GCF-RWL-2106	1'-4"	1'-2"	6"	35

Related Equipment. The AC flash controller is supplied completely assembled. Items required but not supplied are listed below:

- CG-181 solid-state flasher
- 120 Vac continuous
- external wiring
- daylight control, CG-234 type L (if operationally required).

Additional Data. King Electronics Inc., 2021 Valetta St., Philadelphia, Pennsylvania 19124, is the manufacturer of the AC

flash controller. The *Instruction Booklet for GCF-RWL-2106 AC Flash Controller* is available from SUPCEN stock; refer to CG-165-1 for ordering information.

The AC flash controller is available from APA stock; however, Commandant approval by endorsement to the applicable ELECTRONALT is required to order. The stock number is 6350-01-015-0763. A detailed maintenance support outline (MSO) is available for the AC flash controller and may be requested from Commandant (G-EOE).

CHAPTER 9 POWER SYSTEMS

The three major factors that determine the overall power system used on an aid to navigation are electrical load, operational importance, and accessibility for maintenance.

Electrical load establishes the type and capacity of the power supply system. It includes all signal, support, and special system power requirements.

Operational importance determines the reliability and backup power requirements of the power supply system. It includes the relative importance of each signal in the area aids to navigation system.

Accessibility for maintenance refers to the endurance of the power supply system. It includes consideration of the remoteness and inaccessibility of the site and the power system elements.

The standard power system variations are displayed in Figure 9-1. The variation used on an aid to navigation generally depends on the type and amount of power required for the electrical load and the reliability of commercial power.

The type and amount of power required can be categorized as follows:

- Direct Current (dc). Primary (non-rechargeable) batteries serve most float-

ing and many fixed aids. Their use is limited to aids that require less than 6000 Ah/yr. Commercial (ac) power with ac to 12 Vdc conversion serves the remaining (dc) fixed aids--both with and without backup power.

- Alternating Current (ac). Commercial (ac) power is used on many fixed aids--both with and without engine-generator backup power. Prime (engine-generator) (ac) power serves the remaining aids.

The following factors must be weighed when considering the reliability of commercial power:

- If the aid is critical to the area aids to navigation system, backup power for the commercial supply is required.

- If the commercial power is unreliable, backup power is required.

- If a direct current aid uses less than 6000 Ah/yr and is critical, or if commercial power is unreliable, a 120 Vac/12 Vdc battery charger and secondary battery shall be used if commercial power exists or is available from an existing nearby pole line *and* a suitable weather housing exists for the equipment. Otherwise, primary batteries shall be used.

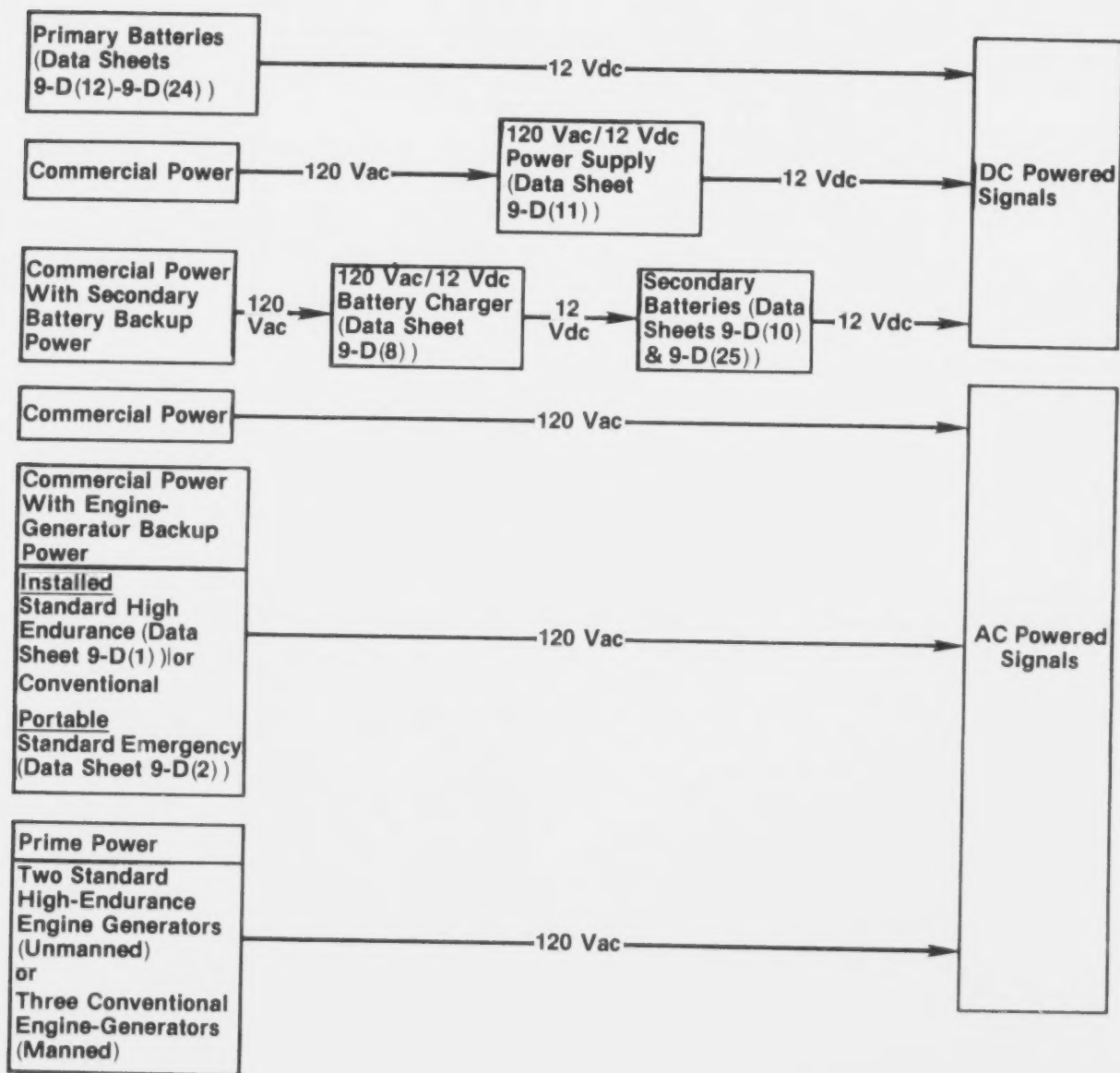


Figure 9-1. Standard power system variations.

A. SELECTION GUIDE

Type of Power Required. The type of primary and backup power systems required for an aid are determined by the type of equipment installed and operational, economic, reliability, and accessibility considerations (See CG-250-41 series publications).

Component Selection

Commercial Power Systems

•Cable. Information on selection of cable is contained in Table 9-1, which specifies characteristics for various cables by type and use. The two cable types according to voltage classification are high voltage (greater than 600 V) and low voltage (600 V or less). Each type is further classified by use--underwater (submarine), overhead, or buried. Notes in Table 9-1 give further selection standards.

•Power Supplies. Information on commercially available power supplies to convert commercial ac line power to 12 Vdc for 12 Vdc signal equipment and other support systems is given on Data Sheet 9-D(11).

•Battery Chargers. Information on commercially available 12 Vdc full float battery chargers is given on Data Sheet 9-D(8).

•Other Requirements. Other commercial power system equipment shall be selected according to individual design features, National Electric Code (NEC) requirements, and individual utility company requirements. Individual design features are influenced by power availability, cost, accessibility for repair, availability of qualified maintenance personnel, and vulnerability to damage.

Engine-Generator Systems

•Size. Standard high-endurance engine-generators are available in 6.5 kW or 10kW (Data Sheet 9-D(1)), while conventional engine-generators vary in size. Care must be exercised

to ensure that the generator selected will not only supply peak power requirements but also be adequately loaded at all times. Generators should operate at 75 percent to 100 percent of rated capacity and in no case shall the generator operate for prolonged periods at less than 50 percent of rated capacity. Failure to observe these guidelines will increase the frequency and cost of required overhauls and degrade the reliability of the equipment.

•Accessories. The following accessories are used on all standard high-endurance engine-generator installations:

- controls--automatic power system controller (Data Sheet 9-D(5))
- starting battery--24 V battery bank consisting of McGraw-Edison HED-100 nickel-cadmium batteries (Data Sheet 9-D(9))
- battery charger--24 V battery charger, model CDSA-1BC (Data Sheet 9-D(6))
- fuel daytank and transfer pumps--standard fuel daytank assembly (Data Sheet 9-D(4))
- environmental controls--standard environmental control unit (Data Sheet 9-D(3)).

The functions of these accessories must be individually engineered for all non-standard (conventional) engine-generator installations.

Primary Batteries

•General Information. Primary batteries are those which cannot be recharged. There are many types of primary batteries. Air-depolarized primary batteries are the type used in the majority of battery powered aids. These batteries require oxygen from the air to operate. Air enters the battery through the carbon electrode. Dry cell primary batteries which do not require oxygen are used for ice buoy and emergency (hot pack) applications.

Table 9-1
Commercial Power Cable Selection Information

<u>TYPE</u>	<u>USE</u>	<u>IDENTIFICATION</u>	<u>CHARACTERISTICS</u>
High voltage	Submarine* (Note 1)	1. USCG (G-EOE) Specification "Specification for Cables, Power, Electrical, 15-kV, Two-Conductor, Concentric Neutral (for underwater Service), Type I and Type II."	1. Power cable, two-conductor, concentric neutral, no. 2 AWG center conductor, 10 no. 14 neutral conductors, 15,000-V insulation; type I cable non-armored, type II cable armored with no. 8 BWG galvanized steel wire.
	Submarine* (Note 2)	2. MIL-C-15479C (Ships), Type 203, Navy Standard Harbor Defense Submarine Cable.	2. Power cable, three-conductor, no. 10 AWG, 2,500-V insulation, no. 10 BWG galvanized steel wire armor; obtained as surplus from Navy when available.
	Submarine * (Note 3)	3. MIL-C-82403 (CG), Type I, same as "U.S. Coast Guard Specifications for Submarine Power, Control, and Communications Cable" (28 February 1972), for type 1-R cable (NSN 6145-00-823-2255).	3. Power cable, three-conductor, no. 6 AWG, 5,000-V insulation, no. 6 BWG galvanized steel wire armor; stocked at CG Supply Center.
	Overhead or buried	This type of cable is specified by power utility companies for each installation in accordance with applicable NEMA, IPCEA, ASTM, and NEC standards.**	
Low voltage	Submarine	1. All high-voltage submarine cables are useable for this application, but cost is generally prohibitive.	
		2. MIL-C-19654 (CG), Type II.	2. Four-conductor, no. 10 AWG, 600-V insulation, 1,000-ft reels (NSN 6145-00-548-2118).
		3. MIL-C-19654 (CG), Type 22.	3. Two-conductor, no. 10 AWG, 600-V insulation, 1,000-ft reels (NSN 6145-00-548-2124).
	Overhead or buried	4. Many cables normally used for direct burial, such as underground residential distribution (URD) cable, can be used if the protective jacket can withstand seawater environment. As with high-voltage cable, the power utility company will specify this cable to meet particular needs of an installation. Since a variety of cables can be used in low-voltage applications, no specific cable is described herein.	

*Note 1, use for all new installations; Note 2, use only for special applications approved by Commandant (G-EOE); Note 3, use only to support existing installations.

**National Electrical Manufacturers' Association (NEMA), Insulated Power Cable Engineers' Association (IPCEA), American Society for Testing and Materials (ASTM), National Electric Code (NEC).

Component Selection (cont'd.)

● Nomenclature. The following nomenclature is used to describe primary batteries:

1. Primary Classification

- a. Use--shore (fixed) aids (S); buoy (B).
- b. Capacity--ampere-hours divided by 100.
- c. Activation procedure--activated by manufacturer (A) and (D). Filled with potable water by user (F).
- d. Electrolyte--non-liquid (D).

2. Shore aid cell designation--shore aid batteries are further designated by the number of cells in each individual battery (one, two, or three) as a prefix to the primary classification symbols.

3. Buoy power units--Buoy power units are supplied factory filled, in some cases with a special reservoir top (R) for cell venting and spill prevention, or with gelatinous electrolyte (D).

Examples:

BIORA--Buoy power unit, 12V, 1000 Ah with reservoir tops, activated by manufacturer (McGraw-Edison).

B30D--Buoy power unit, 12V, 3000 Ah, gelatinous electrolyte, activated by manufacturer (SAFT).

3S30D--Three cell, 1.25V, 3000 Ah fixed aid battery, gelatinous electrolyte, activated by manufacturer (SAFT).

2S10F--Two cell, 2.5V, 1000 Ah fixed aid battery, activated by user adding water.

● Standard Applications

1. Current capacity--Primary batteries have a limited current discharge rate. The first step in the selection process must be to ensure that a given lamp size and flash characteristic are properly matched with battery capacity in accordance with Table 9-2.

2. Battery capacity--Battery capacity shall be selected for a given installation

so that recharge periods are at least 1 yr, but not more than 3 yrs.

3. Rated battery discharge time (RBDT)--Rated battery discharge time is the expected total useful operating days of a battery based on the applied loads. It is found by dividing battery capacity by average daily current consumption. The RBDT is used to find when batteries in continuous service should be replaced by counting forward from the installation date the number of RBDT days. RBDT's for combinations of lamp size and rhythm or sound signal and duty cycle which satisfy current and battery capacity limitations can be obtained directly from Table 9-3 for battery capacities of 1000, 2000, 3000, and 6000 Ah. Tabular data account for adequate safety factors for most installations and battery life should not be further derated without special justification. The RBDT can also be calculated as follows:

a. Basic equation:
$$RBDT = \frac{Bc}{Dcc}$$

where Bc = battery capacity in ampere-hours

Dcc = average daily current consumption in ampere-hours

b. Equation for daylight controlled lights using CG-181 flasher:

$$RBDT = \frac{Bc}{Dcc(13)} - \text{RBDT Correction Factor (Table 9-4)}$$

where $\frac{Bc}{Dcc(13)}$ = battery service life with 13 hour/day operation

Dcc(13) = average daily current consumption in ampere-hours with 13 hour/day operation

$$Dcc(13) = (I_{avg}) \times (D) \times (H) + F_d$$

I_{avg} = average lamp current in amperes (Table 9-5)

Component Selection (cont'd.)

D=duty cycle (Table 9-5)

H=daily hours of operation
(use 13 hrs.)

Fd=daily flasher dissipation in
ampere-hours (Table 9-5)

4. Lamp life--for some flasher/lamp combinations, the rated life of six lamps in the CG-6P lampchanger will be less than the RBDT. In such cases, a special notation shall be made on the SANDS type form to indicate that lamp replacement time is less than the RBDT for that particular aid. All such combinations are marked with an asterisk (*) on the RBDT tables to indicate that reference to table 9-2 is necessary to determine rated lamp life.

5. Type of activation--Preactivated (A,D) batteries (with the electrolyte installed by the manufacturer) shall be used except in locations where the difficulty or cost of transporting them is prohibitive. User-activated (F) batteries, which are filled with potable water by the installer, are authorized only in locations where the

problems and costs of transporting liquid-filled preactivated batteries to the site outweigh and tend to cancel the greater reliability of factory-activated batteries. All primary batteries require air to function; therefore ensure that their vents are not covered. Remove sealing tape from SAFT battery cells (including those in buoy power units) prior to use.

- Special Applications

1. Seasonal Aids--Battery capacity for seasonal aids shall be selected to make maximum use of battery capacity over complete operating seasons so battery installation and servicing can coincide with planned beginning and sometimes end of season service visits. For most lamp, rhythm, and battery capacity combinations this results in either one- or two-season battery use. For several low power combinations, three seasons are permitted, but where batteries are transported between seasons, the limit is two seasons. To select capacities to suit other season lengths, find the number of seasons where the total of in-season battery operating days does not exceed

Table 9-2
Maximum Allowable Lamp Size and CG-6P Lamplife

Rhythm	Maximum Allowable Lamp Size (A) for Battery Capacity				CG-6P Lamp Life (years + days)
	1,000Ah	2,000Ah	3,000Ah	6,000Ah	
FIXED	.25	.55	.77	2.03	0+190
Oc 4	.25	.77	1.15	2.03	0+215
Iso 6	.55	1.15	1.15	3.05	0+325
FI(2)6	.77	1.15	2.03	3.05	1+125
Q	.77	1.15	2.03	2.03	1+175
Mo(A)	.77	1.15	2.03	3.05	1+175
FI 4(1.0)	.77	1.15	2.03	3.05	1+285
IQ	1.15	1.15	2.03	2.03	2+170
FI(2)5	1.15	2.03	3.05	3.05	2+285
FI(2+1)6	1.15	2.03	2.03	2.03	2+300
FI 2.5(.3)	1.15	2.03	2.03	2.03	2+305
FI 4(.4)	1.15	2.03	3.05	3.05	4+ 65
FI 6(.6)	1.15	2.03	3.05	3.05	4+ 65

Table 9-3
Battery Capacity Selection Guide
(RBDT in years + days)

1,000-Ah batteries (S10A, S10F, B10A, B10F, B10RA)

Rhythm	Lamp Rating (amperes)				
	.25	.55	.77	1.15	2.03 3.05
FIXED *					
Oc 4 *					
Iso 6 *	1+104				
FI(2)6	1+344				
Q	2+ 11				
Mo(A)	2+ 34	1+ 23			
FI 4(1.0)	2+116	1+ 73			
IQ	3+000	1+160	1+ 43		
FI(2)5	3+000	1+260	1+ 82		
FI(2+1)6	3+000	1+290	1+ 90		
FI 2.5(.3)	3+000	2+ 56	1+199	1+ 35	
FI 4(.4)	3+000	2+201	1+358	1+ 92	
FI 6(.6)	3+000	2+243	2+ 11	1+108	
		<u>Duty Cycle</u>			
<u>Sound Signal</u>	10%	13.3%	20%		
SA-850	1+ 40				

2,000-Ah batteries (S20A, S20F, (2)B10A, (2)B10RA, (2)B10F, B20RA)

Rhythm	Lamp Rating (amperes)				
	.25	.55	.77	1.15	2.03 3.05
FIXED *	1+123				
Oc 4 *	1+327				
Iso 6 *	2+258	1+101	345		
FI(2)6	3+000	1+345	1+113		
Q	3+000	1+358	1+105		
Mo(A)	3+000	2+ 46	1+167	1+ 51	
FI 4(1.0)	3+000	2+156	1+301	1+ 70	
IQ		3+000	2+ 76	1+137	
FI(2)5		3+000	2+174	1+249	
FI(2+1)6		3+000	2+220	1+280	
FI 2.5(.3)		3+000	3+000	2+ 59	1+ 56
FI 4(.4)		3+000	3+000	2+234	1+127
FI 6(.6)		3+000	3+000	2+295	1+183
		<u>Duty Cycle</u>			
<u>Sound Signal</u>	10%	13.3%	20%		
SA-850	2+ 70	1+218	1+ 40		
FA-232	1+ 24				

*Refer to Table 9-2 to determine rated lamp life

Table 9-3 (cont'd)

3,000-Ah batteries (S30A, S30F, B30A, B30RA, B30F)

Rhythm	Lamp Rating (amperes)					
	.25	.55	.77	1.15	2.03	3.05
FIXED *	2+ 56	1+ 18				
Oc 4 *	2+313	1+ 98	1+ 13			
Iso 6	3+000	2+ 19	1+127	1+ 10		
FI(2)6	3+000	2+340	2+ 37	1+115		
Q	3+000	2+353	2+ 40	1+100		
Mo(A)		3+000	2+ 93	1+259		
FI 4(1.0)		3+000	2+279	1+325	1+ 25	
IQ			3+000	2+ 73	1+ 65	
FI(2)6			3+000	2+196	1+113	
FI(2+1)6			3+000	2+239	1+119	
FI 2.6(.3)				3+000	1+277	
FI 4(.4)				3+000	2+ 68	1+119
FI 6(.6)				3+000	2+117	1+176

Sound Signal	Duty Cycle		
	10%	13.3%	20%
SA-850	3+000	2+154	1+218
FA-232	1+189	1+ 40	
FA-232 (bell conversion)	1+ 51		

6,000-Ah batteries ((2)S30A, (2)S30F, (2)B30A, (2)B30RA, (2)B30F)

Rhythm	Lamp Rating (amperes)					
	.25	.55	.77	1.15	2.03	3.05
FIXED *	3+000	2+ 36	1+158	1+ 25		
Oc 4 *	3+000	2+273	2+ 16	1+ 99		
Iso 6		3+000	3+000	2+ 20	1+ 47	
FI(2)6		3+000	3+000	2+322	1+204	1+ 26
Q			3+000	2+280	1+121	**
Mo(A)			3+000	3+000	1+293	1+ 61
FI 4(1.0)				3+000	2+ 50	1+113
IQ				3+000	2+150	**
FI(2)6				3+000	2+313	1+293
FI(2+1)6				3+000	3+000	**
FI 2.6(.3)					3+000	**
FI 4(.4)					3+000	2+301
FI 6(.6)					3+000	3+000

Sound Signal	Duty Cycle		
	10%	13.3%	20%
SA-850		3+000	3+000
SA-850/02	1+201		
FA-232	3+000	2+ 80	1+189
FA-232/02	1+124	1+ 20	
FA-232 (bell conversion)	2+ 63	1+259	

*Refer to Table 9-2 to determine rated lamp life

**Lamp size/flasher combination not authorized because of short flash duration vs lamp incandescence time

Table 9-4
RBDT Correction Factor

$\left[\frac{B_c}{D_{cc}(13)} \right]$ Battery Service Life at 13 Hr/Days (days)				RBDT Correction Factor (days)
365 - 390	721 - 735	736 - 750	1,081 - 1,095	0
391 - 420	691 - 720	751 - 780	1,051 - 1,080	10
421 - 450	661 - 690	781 - 810	1,021 - 1,050	20
451 - 480	631 - 660	811 - 840	991 - 1,020	30
481 - 510	601 - 630	841 - 870	961 - 990	40
511 - 540	571 - 600	871 - 900	931 - 960	50
541 - 553	556 - 570	901 - 915	916 - 930	60

NOTE: The RBDT correction factor is based on environmental factors and component tolerances. It is only required when computing your own RBDT's.

Table 9-5
CG-181 Flasher Characteristics:
Duty Cycle, Flasher Dissipation, and Average Lamp Current

Rhythm	[D] Duty Cycle (%)	[Fd] Flasher Dissi- pation (Ah)*	[Iavg] Average Lamp Current (amperes)** for Rated Lamp Sizes					
			.25	.55	.77	1.15	2.03	3.05
FIXED	1.00	0.456	.250	.550	.770	1.15	2.03	3.05
Oc 4	0.75	0.391	.252	.559	.785	1.18	2.10	3.17
Iso 6	0.50	0.326	.252	.559	.785	1.18	2.10	3.17
FI(2)6	0.33	0.284	.258	.578	.816	1.24	2.23	3.42
Q	0.30	0.274	.278	.639	.916	1.42	2.76	
Mo(A)	0.30	0.274	.262	.592	.844	1.29	2.38	3.70
FI 4(1.0)	0.25	0.261	.258	.578	.816	1.24	2.23	3.42
IQ	0.18	0.243	.278	.639	.916	1.42	2.76	
FI(2)5	0.16	0.238	.271	.621	.894	1.38	2.62	4.15
FI(2+1)6	0.15	0.235	.278	.639	.916	1.42	2.76	
FI 2.5(.3)	0.12	0.228	.278	.639	.916	1.42	2.76	
FI 4(.4)	0.10	0.222	.271	.621	.894	1.38	2.62	4.15
FI 6(.6)	0.10	0.222	.266	.596	.859	1.31	2.45	4.81

*Flasher dissipation in ampere-hours is based on 13 hr/day operation at 60°F. Add 0.10 Ah for average temperatures over 80°F. Flasher dissipation is the same for all flashers with the same duty cycle.

** Average lamp current includes cold filament surge current and is the same for all flashers with the same flash duration.

Component Selection (cont'd)

the RBDT. The period when the battery is disconnected and/or stored is treated the same as shelf life time between manufacture and installation dates. Battery capabilities are to be chosen and batteries used so that they never accumulate more than 365 shelf life and/or storage days. Batteries which do accumulate more shall be derated 1 day for every excess day.

2. Ice buoys--Only specially designed dry-type primary batteries (Data Sheet 9-D(21)) are authorized for use in ice buoys. These batteries have a very short shelf life and for this reason their use or storage is restricted to one season (regardless of whether they are used). Ice buoys do not have vented pockets because they may be frequently submerged in service and this, together with the shock loads encountered, precludes the use of air-depolarized batteries. Table 9-7 lists the standard flasher/lamp combinations/RBDT for ice buoy batteries.

3. Emergency use--Emergency (hot pack) dry cell zinc-carbon type primary batteries (Data Sheet 9-D(22)) are primarily used as a temporary power source on aids

when the regular air-depolarized batteries have failed and cannot be immediately replaced. They are also used on discrepancy buoys. Because the rated battery life of this battery type is extremely dependent on shelf-life history (particularly temperature during storage), no precise battery life predictions can be made. In most cases, they are not necessary since replacement primary batteries are installed in a short time. However, for situations such as discrepancy buoy deployment, Table 9-8 gives expected battery life.

Secondary Battery Systems. This section describes secondary battery systems that provide dc power to emergency light and sound signals on Category I, II and III aids and to main 12 V signals on Category IV aids.

•Battery Type. Nickel-cadmium batteries with pocket type plates or stationary lead-acid batteries with lead calcium plates designed specifically for long float life service shall be used for all installations that require secondary battery backup power.

Table 9-6
Battery Capacity Guide for Seasonal Aids*

Rhythm	Lamp Size (amperes)					
	.25	.55	.77	1.15	2.03	3.05
FIXED **	1,000 (----)	3,000 (----)	3,000 (----)	6,000 (----)	---	---
Oc 4 **	1,000 (----)	2,000 (----)	2,000 (----)	6,000 (----)	6,000 (----)	6,000 (----)
Iso 6 **	1,000 (----)	1,000 (----)	2,000 (----)	2,000 (----)	6,000 (----)	6,000 (----)
FI(2)6	1,000 (1,000)	1,000 (----)	2,000 (3,000)	2,000 (----)	3,000 (----)	6,000 (----)
Q	1,000 (1,000)	1,000 (----)	1,000 (----)	2,000 (----)	3,000 (----)	---
Mo(A)	1,000 (1,000)	1,000 (----)	1,000 (----)	2,000 (3,000)	3,000 (----)	6,000 (----)
FI 4(1.0)	1,000 (1,000)	1,000 (----)	1,000 (----)	2,000 (3,000)	3,000 (----)	6,000 (----)
IQ	1,000 (1,000)	1,000 (----)	1,000 (----)	1,000 (----)	3,000 (----)	---
FI(2)5	1,000 (1,000)	1,000 (1,000)	1,000 (----)	1,000 (----)	2,000 (3,000)	6,000 (6,000)
FI(2+1)6	1,000 (1,000)	1,000 (1,000)	1,000 (1,000)	1,000 (----)	2,000 (3,000)	---
FI 2.5(.3)	1,000 (1,000)	1,000 (1,000)	1,000 (1,000)	1,000 (----)	2,000 (3,000)	---
FI 4(.4)	1,000 (1,000)	1,000 (1,000)	1,000 (1,000)	1,000 (----)	2,000 (3,000)	3,000 (----)
FI 6(.6)	1,000 (1,000)	1,000 (1,000)	1,000 (1,000)	1,000 (----)	2,000 (2,000)	3,000 (----)

*Battery capacities without parenthesis will operate the aid for one season and those with parenthesis will operate the aid for two seasons. Battery capacities with parenthesis and underlined will operate the aid for three seasons.

**CG-6P lamp life less than 9 months.

Component Selection (cont'd)

•Battery Size. Battery capacity shall be selected to ensure signal operation for a minimum of 8 days. Use 11.0 V as the battery cutoff voltage and consider the effects of temperature (particularly on lead-acid batteries) when sizing bat-

teries according to manufacturer's instructions.

•Battery Chargers. Information on battery chargers is provided on Data Sheet 9-D(8).

Table 9-7
Ice Buoy Dry Cell RBDT in Days

<u>Rhythm</u>	<u>250 Ah</u>			<u>320 Ah</u>		
	<u>Lamp Rating (Amperes)</u>					
	<u>.25</u>	<u>.55</u>	<u>.77</u>	<u>.25</u>	<u>.55</u>	<u>.77</u>
Fixed	60			75		
Oc 4	90			115		
Iso 6	120			150		
Fl(2)6	180	90		180	115	
Q	180	90		180	115	
Mo(A)	180	90		180	115	
Fl 4(1.0)	180	90		180	115	
IQ	180	120	90	180	150	115
Fl(2)5	180	150	120	180	180	150
Fl(2+1)6	180	170	120	180	180	160
Fl 2.5(.3)	180	180	150	180	180	180
Fl 4(.4)	180	180	180	180	180	180
Fl 6(.6)	180	180	180	180	180	180

Table 9-8
Emergency (Hot Pack) Primary Battery RBDT in Days

Rhythm	Lamp Rating (amperes)			
	.25	.55	.77	1.15
FIXED	6	3	2	1
Oc 4	8	3	2	1
Iso 6	11	5	4	2
Fl(2)6	16	8	6	4
Q	17	8	6	4
Mo(A)	18	9	6	4
Fl 4(1.0)	21	10	8	5
IQ	26	13	9	6
Fl(2)5	29	15	11	7
Fl(2+1)6	32	17	12	8
Fl 2.5(.3)	35	19	14	9
Fl 4(.4)	41	22	16	11
Fl 6(.6)	42	23	17	12

B. PREPARATION AND INSTALLATION

Commercial Power Systems. All commercial power systems shall be installed according to the National Electric Code (NEC) and individual utility requirements. Additional information is contained in the *Civil Engineering Manual* (CG-251).

Engine-Generator Systems

Equipment Condition as Delivered.

Standard high-endurance engine-generators are delivered assembled and in a substantially ready-to-run status after making necessary connections. They have been run at the factory under load and no further break-in is required. The condition of conventional engine-generators must be individually determined.

Preinstallation Checkout

•Accessories. All engine-generator accessories (i.e., controls, starting batteries, battery charger, fuel daytank assembly) shall be connected and tested with the engine-generator. Consult individual equipment instruction manuals for specific preparation and installation requirements.

•System Check. The Prime Power Checkout Procedure for Automated Lighthouses (COMDTINST M10500.38) gives detailed checkout procedures for automated lighthouses using standard equipment. These procedures must be modified as necessary for conventional engine-generator systems.

Installation. Engine-generators shall be installed in accordance with Commandant (G-EOE) Drawing Nos. 130115 and 130116, as amplified by district-prepared plans and instructions. Once connected to the operating load, the system check described above for pre-installation checkout shall be again performed. Prior to declaring the installation operational, the engine-generator shall be run under the operating load for at least 24 hr with installation personnel in attendance.

Primary Batteries

Air-Depolarized Batteries

•Inspection. All batteries shall be inspected for manufacturing defects and shipping damage by the installing unit. A claim shall be made against the manufacturer or carrier, as appropriate. Corrective action shall be taken in accordance with Table 9-9.

•Storage

1. Requirements--Batteries shall be stored in sealed shipping cartons in a clean, dry location. Storage temperatures above 75°F severely affect shelf life and may cause premature failure of batteries. Batteries may be stored outside in an environmentally protected location not subjected to high temperatures. Cartons shall remain sealed until activation or use. User-activated batteries shall be activated immediately if the shipping container has been damaged to prevent damaging humidity activation of the battery. All batteries shall be stored in an upright position.

2. Shelf life--Air-depolarized batteries shall be used as soon as practicable after receipt. Batteries which have been in storage shall always be placed in use before newly received batteries. Batteries which show signs of deterioration after storage shall not be placed in service. Every possible attempt shall be made to place batteries in service within 1 yr of the date of manufacture. Batteries in storage for more than 1 yr shall be derated 1 day for every excess day in storage.

•Installation

1. Figures 9-2 through 9-4 show standard installation of primary batteries within standard CG battery boxes. The standard CG plastic battery box protects batteries from the elements and is capable of holding a total of six 2S10, six 2S20,

Table 9-9
Air-Depolarized Battery Inspection Requirements

<u>DEFECT</u>	<u>REQUIREMENT</u>
Battery case	
Cracks	Replace battery
Bulges, deformation	Replace battery
Leakage	Replace battery
Plastic bags	
None	New bag
Torn	New bag
Carrying device	
Loose bail	Remove from battery
Frayed lifting strap	Replace strap
Battery terminals	
Loose connections	Tighten
Corroded	Clean, tighten
No lockwasher	Add lockwasher
Dust covers	
No dust filter	Replace filter
Detached cover	Secure to battery
Venting device	
Leaking vent valve	Replace vent valve
Clogged, stuck	Clean, replace
Electrolyte	
Proper level	Add potable water
Humidity in "dry" battery	Fill with potable water
Leakage at pitch seal	Replace battery
Carbon cathode	
Cracked	Replace battery
Saturated with electrolyte	Replace battery
Loose	Replace battery
Zinc anode	
Loose	Replace battery
Heavy flaking, swelling	Replace battery
Lime bed	
Low, powdered	Replace battery
Blue mud	Replace battery
Marking	
No classification	Add battery type
No shelf life date	Add expiration date
No date of manufacture	Add date of manufacture
Power unit rack	
No lifting eye	Add lifting eye
Stained, damaged	Check for leaking battery
Loose, no steel bands	Replace bands
No reversible spacers	Add spacers
No antirotational device	Add device
No terminal block	Add terminal block

Primary Batteries (cont'd)

six 1S30F, or five 3S30* batteries. Each battery box has built-in vents. During installation ensure all vents are clear so that an adequate air supply is provided to the batteries.

2. Batteries used in the same installation shall be matched by date of manufacture and maintained in a level, upright position within the leakage-containing plastic bag. Electrolyte level shall be above the zinc plates at the indicated height on the case.

3. Batteries shall normally be procured from the manufacturer prewired to the proper ampere-hour capacity--1000 Ah, 2000 Ah, or 3000 Ah. When necessary in the field to make cell-to-cell connections, always use manufacturer-supplied bus bars. Battery-to-battery wiring shall be made using manufacturer-supplied wire leads or type SO2, 12-AWG cable. Installations that require 4000 Ah or 6000 Ah shall be made by paralleling 2000- or 3000-Ah banks of batteries, respectively. After connections are made, a light coating of anticorrosion agent, such as petrolatum, shall be applied to each connection.

•Buoy Installation. Buoy power unit installation requires careful handling of battery racks and as short a laydown time as possible to reduce the chances for electrolyte leakage. Each power unit has two steel braces attached to the base which brace the bottom of the rack against the inside of the buoy pocket. These braces are reversible to allow snug fit in either 22- or 24-in. buoy pockets. Do not discard these feet.

A power assembly clamp shall be securely attached to the top of each power unit. Only one orientation of the clamp will allow easy access to the terminal block for wiring connections and engage the antirotational bracket on top of each power unit. The clamp prevents the buoy power unit from moving within the buoy pocket after its positioning bolts are tightened against the buoy pocket walls. (See Data Sheet 9-D(24).)

Buoy pockets are vented to allow air-depolarized batteries to "breathe." Vent pipes must remain clear and free of obstructions and buoy ballast shall not consist of spalling concrete or rusting chain (see Chapter 2).

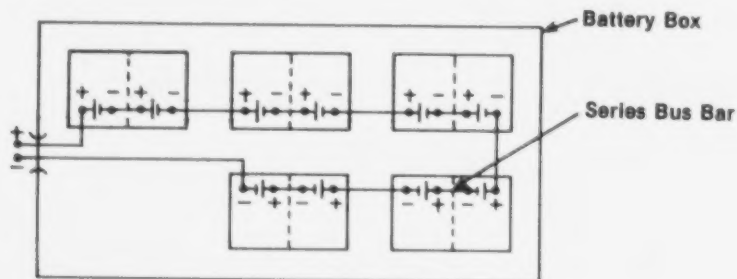


Figure 9-2. 12 V, 1000 Ah battery bank installation using five 2S10 batteries.

*The addition of the plywood platform (Data Sheet 9-D(23)) is required prior to installation of the five 3S30 batteries.

Primary Batteries (cont'd)

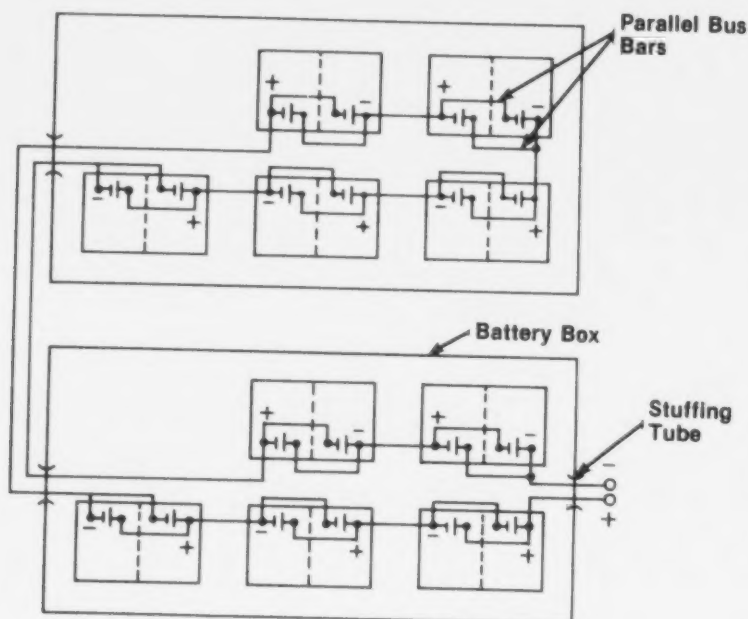


Figure 9-3. 12 V, 2000 Ah battery bank installation using 10 2S20 batteries.

Emergency Power Batteries. Emergency power for aids (buoy or shore) that cannot be properly serviced immediately is supplied by wiring three 6 V "hot pack" dry cells in series for an initial voltage of 18 V. Prior to connecting the hot pack to the flasher, the wiring connections from the failed battery bank must be removed to prevent hot pack damage. Hot pack voltage is regulated to 12 V by the CG-181 flasher. Hot packs are normally secured to the aid in a canvas bag strapped to the structure.

Hot pack or emergency dry cell batteries have relatively short shelf storage lives due to self-discharge characteristics. These batteries shall not be used for aids to navigation if the storage period exceeds 6 mo. Cool storage temperatures are recommended by the manufacturer to ensure rated battery capacity in use. Temperatures of 40 to 50°F are considered most effective. Never wire the 6 V hot pack batteries together before storage.

Ice Buoy Batteries. Ice buoy batteries are sealed dry cells that are installed in special unvented ice buoys in areas where ice affects normal buoy operation. These batteries shall be handled with the same care as air-depolarized batteries. Power connection is made to the two terminal posts on the top.

Ice buoy batteries shall not be stored for more than 6 mo before use. They shall be used only during the current ice season. Because of their self-discharge characteristics, they shall not be retained for a following ice season.

Secondary Battery Systems. Secondary batteries of the stationary lead-acid or nickel-cadmium "pocket" plate type are shipped with detailed instructions for installation and maintenance--these instructions shall be posted for reference. Each cell is shipped pre-activated and fully charged and shall be checked for proper electrolyte level

Secondary Battery Systems (cont'd)

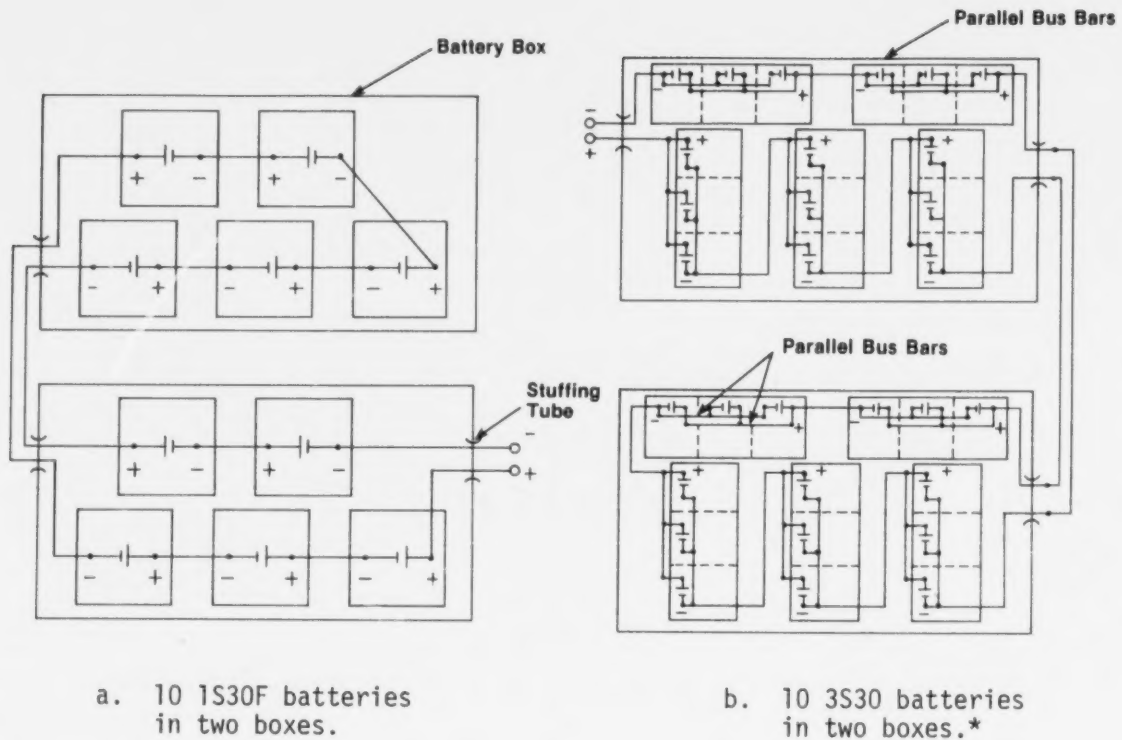


Figure 9-4. 12 V, 3000 Ah battery bank installation using (a) 10 1S30F batteries in two battery boxes and (b) 10 3S30 batteries in two battery boxes.

*Data Sheet 9-D(23) describes the plywood platform necessary to raise 3S30 batteries 3-1/2 in. in order to fit five in each battery box.

and shipping damage prior to installation.

Storage. Secondary batteries shall be stored in a clean, dry place. Lead-acid and nickel-cadmium batteries shall never be stored together. Hydrometers used on lead-acid batteries shall *never* be used on nickel-cadmium batteries or even left in the same vicinity.

Preparation. Add the appropriate electrolyte to each cell if necessary. Cells stored for more than 60 days shall be recharged to make up for lost capacity through self-discharge.

Installation. Install secondary batteries upright and level. Clean and

coat all connection points with protective lubricant to prevent oxidation according to manufacturer's specifications. Use manufacturer-supplied bus bars for cell-to-cell connections. Connect six lead-acid cells or 10 nickel-cadmium cells in series to provide nominal 12 V. Ensure that battery charger float and equalize charge voltages are accurately set. Use the float charge voltage supplied by the battery manufacturer for the normal battery operating temperature at the site. Locate temperature-compensation sensors as close as possible to battery cells. All final float and equalizing voltage settings must be made with the battery bank in a fully charged condition.

C. INSPECTION, MAINTENANCE, AND REPAIR ON STATION

Commercial Power Systems

High Voltage Systems (greater than 600 V). Maintenance of high voltage systems requires special knowledge, equipment, and techniques that are normally beyond the qualification level of assigned maintenance personnel. Therefore, maintenance and repair shall be performed on a contract basis by a private contractor or commercial utility. The only exception is Coast Guard owned and installed submarine cable systems where maintenance and repair of "free and clear" (disconnected at both ends) cable is generally performed by Coast Guard personnel.

Low Voltage Systems (600 V or less). Coast Guard installed low voltage systems are generally maintained by Coast Guard personnel. Low voltage systems that are owned and operated by a commercial utility are its maintenance responsibility.

Engine-Generators

Routine Servicing

•Intervals

1. Standard high-endurance engine-generators--These sets are designed for up to 90 days of continuous running at automated sites between servicing visits.
2. Portable emergency engine-generators--Requirements for changing lube oil on these sets limit unattended operation to 5 days. Lube oil extender kits can be built to increase unattended operation to 90 days. Consult Commandant (G-EOE) for further information.
3. Conventional engine-generators--Servicing requirements vary with individual designs. They are primarily dependent on lube oil capacity. Backup engine-generators of this type shall be exercised under load for 2 hr at least every 2 wk to ensure operational readiness.

•Routine Servicing Items. Table 9-10 gives general inspection and maintenance requirements for most engine-generators during normal servicing visits. Individual instruction manuals provide recommended intervals for accomplishment of these items and show additional items peculiar to specific engine-generator sets. During routine service visits, personnel shall also evaluate engine-generator performance to detect potential discrepancies for immediate or deferred repairs.

Repair Onsite. Table 9-11 gives engine-generator repair items that would normally be accomplished by qualified personnel onsite prior to removal for Group or Industrial Base repair or overhaul.

Criteria for Removal for Base Overhaul. Engine-generators shall be removed from the site for major overhaul when directed by the District or Group engineering staff, based on the following criteria:

- when the engine performs abnormally or will not carry the signal load after all possible onsite corrective actions have been taken (abnormal operation includes excessive vibration or excessive lube oil consumption)
- when lube oil analyses show an alarming metal wear rate based on at least two successive samplings
- when the operating hours on the engine warrant a planned overhaul based on experience and operational data on the same or similar engine-generators, even though current engine-generator performance is satisfactory.

Base Overhaul Guide Specification. The Overhaul Guide Specification for Lister SR Series Diesel Engines (COMDT-INST M10500.39) gives detailed procedures for base overhaul.

Table 9-10
Engine-Generator Routine Servicing Procedures

<u>SYSTEM</u>	<u>INSPECTION/MAINTENANCE TASK</u>
General	1. Inspect and correct obvious minor deficiencies, such as loose or missing bolts, nuts, or pins; leaking covers and gaskets; loose or damaged wiring, terminals, and connections. 2. Inspect and clean air cooling fan blades and air intake filter. 3. Inspect mufflers and exhaust pipe.
Engine	1. Start and operate under load. 2. Inspect for normal operation and identify abnormal conditions. 3. Make speed adjustments as necessary. 4. Test all engine protective safety devices.
Fuel	1. Replace or clean fuel filter elements. 2. Inspect and repair leaks or damaged internal and external fuel supply and return lines. 3. Clean injection nozzle cooling fans. 4. Replace faulty fuel pump when necessary. 5. Prime fuel system after making repairs.
Lubrication	1. Take lube oil sample for submission to lube oil analysis laboratory. 2. Check oil level and add when necessary. 3. Change lube oil filters at required intervals. 4. Repair leaking or damaged lube oil lines and fittings.
Electrical	1. Inspect and clean generator air inlet screen. 2. Check generator bearings for abnormal noise or overheating. 3. Check power output voltage and frequency under load. 4. Lubricate starter motor as necessary.

Table 9-11
Engine-Generator Repairs Onsite

<u>SYSTEM</u>	<u>REPAIR ITEM</u>
Engine	1. Check and adjust valves. 2. Adjust or replace engine speed governor. 3. Perform top overhaul when warranted to restore diminished performance. 4. Check injector spray pattern and replace nozzle if necessary. 5. Check and adjust injection timing. 6. Install and adjust injection pump. 7. Inspect, adjust, and replace fuel stop solenoid as necessary.
Electrical	1. Replace starter motor and test for proper operation. 2. Replace and test voltage regulator.

Engine Generators (cont'd)

Accessories. Engine-generator accessories, such as power controllers, starting batteries, battery chargers, fuel daytanks and transfer pumps, and environmental controls are routinely serviced during visits for servicing engine-generators and other aid equipment (according to recommendations in individual instruction manuals). All are designed as low maintenance equipment. Repair usually consists of substituting major components or replacing with new equipment and removing the defective equipment for repair at other facilities.

Primary Batteries. Primary batteries shall be replaced before the RBDT is exceeded or when voltage determined during servicing is less than specified in this section.

Servicing of Fixed Aids. Fixed aids to navigation batteries shall be serviced at least once every 12 mo. Batteries shall be handled with care during servicing to prevent damage. The following shall be accomplished:

The battery box (and batteries) shall be leveled. An inclined battery leaves the zinc plate partially exposed in liquid batteries, causing excessive plate corrosion and premature failure.

- Wiring and wiring connections shall be cleaned of corrosion and tightened, and coated with a thin film of petroleum jelly or similar protective lubricant after tightening.

- Wiring disconnected from the load on seasonal aid batteries left in battery boxes shall be separated and taped to prevent shorting.

- Batteries shall be visually checked for low electrolyte level, wet carbons, and electrolyte leakage. Wet carbons (saturated with electrolyte) and leakage require battery replacement. A low electrolyte level requires the addition

of potable water.

- Load Tests. Using a calibrated voltmeter, measure the voltage of the system after the voltage levels off (at least 10 minutes) under the following loads:

- 1000 AH batteries - 40 ohm resistor
- 2000 AH batteries - 20 ohm resistor (or two 40 ohm resistors in parallel)
- 3000 AH batteries - 13.33 ohm resistor (or three 40 ohm resistors in parallel)

Lab tests show that the total system voltage under these loads continuously to 40% RBDT will be 12.3 V to 12.7 V at 70 degrees F for healthy batteries. The same batteries will read 0.5 V to 0.6 V lower at 10 degrees F under the same load. For shore aids measure the voltage of each cell while load is applied. Cells that are more than 0.1 V below the average should be replaced in batteries that are not yet at 50% of RBDT. For aids beyond 50% of RBDT, all batteries should be replaced if one or more cells is low. High cell readings may be caused by poor connections. If it is not possible to use resistors, use the following lamps burning continuously until voltage levels off: 1000 AH-0.55a lamp, 2000 AH-0.77 A lamp, 3000 AH-1.15 A lamp. The higher currents drawn by these loads will produce overall voltage readings below those quoted for the resistor loads.

- If any system components are found to be drawing excess current, the batteries shall be replaced or derated.

Servicing of Floating Aids. The servicing procedure for buoys is the same as described for fixed aids except that opening pockets to inspect batteries is not required if the overall load test voltage is acceptable. Buoy power units for seasoned aids shall be stored in an upright position, regardless of battery type used. If power units are left in buoys, wires shall be disconnected from the load, separated, and taped to prevent shorting.

Disposal of Primary Air-Depolarized Batteries

•Requirements. Primary air-depolarized batteries contain certain hazardous materials and must be transported, stored, handled, and disposed of as hazardous waste in accordance with Federal, state, and local regulations.

In some states, the federal Environmental Protection Agency (EPA) (versus the state) now regulates handling, transportation, storage and disposal of hazardous wastes. There are four categories of hazardous wastes: corrosivity, ignitability, reactivity and EP toxicity. Both the McGraw-Edison and SAFT (liquid and gel) batteries used in aids to navigation are hazardous wastes for disposal purposes. The batteries contain a very caustic (corrosive) electrolyte (potassium hydroxide) with a pH of 13.6 to 14. They also fail the EP Toxicity test for mercury. EPA has allowed many states to adopt their own hazardous waste programs provided they are similar to EPA's. In these cases the state regulations must be complied with rather than EPA's. District instructions should be consulted. Commandant (G-WP-4) (FTS 426-1106) can provide names of states in which the EPA regulations do not apply.

As a hazardous waste the batteries must be sent to a chemical landfill for disposal. There are two methods of accomplishing this: (1) Using DPDS. The Coast Guard (Commandant G-FLP) has a Memorandum of Understanding with Defense Property Disposal Service (DPPS) for the DPDS to provide the same level of support offered the DOD military services for the disposal of hazardous materials and wastes on a reimbursable basis. Many DPDS facilities accept the spent batteries as a hazardous material rather than a hazardous waste. This can save significant amounts of time, paperwork, and record keeping. (2) Using commercial facilities. You can contract directly with the chemical landfill. In

either case rigorous EPA or state regulations must be complied with and the Coast Guard cannot transfer its liability for following them. This liability is placed directly on hazardous waste generators (i.e. CG operating units).

All hazardous waste generators, except small quantity generators (less than 1000 kg/month), are held responsible for using a manifest system, using authorized transporters and disposal facilities (which may be costly), ensuring proper packaging, labeling and marking in accordance with EPA/DOT regulations, record keeping and filing of annual reports. It is Coast Guard policy to allow groups and bases to relieve ships and small Aton servicing units of being registered hazardous waste generators of used primary batteries (small quantity generators, i.e. those generating less than 1000 kilograms per month, are excluded from registering with EPA). To avoid becoming treatment, storage, and disposal facilities (TSDF) Coast Guard units must not store hazardous waste for more than 90 days. TSDFs have very strict regulations including ground water monitoring, which can be very expensive and should be avoided. These requirements for generators, transporters and TSDFs are found in 40 CFR 260-266.

Prohibited Disposal Methods. The following disposal methods shall not be used:

- Use of local incinerator facilities
- ocean or other water dumping
- disposal by casual inclusion in local trash or refuse collection
- uncontrolled dumping in local landfills, unless expressly approved by Federal, state, or local authorities
- open burning with other refuse or combustible materials
- abandonment of batteries at or around the site of shore or fixed aids
- use as ballast in a buoy pocket
- neutralization at CG facilities.

Primary Batteries (cont'd)

NOTE: Federal EPA regulations allow small quantity generators to use sanitary landfills, but state regulations should be checked before doing so. The operator of the facility should be informed of the caustic electrolyte (pH 13.6 to 14) and the mercury content in the batteries. A Material Safety Data Sheet should be presented. Copies can be obtained from Commandant (G-EOE).

Transportation and Packaging. District Commanders shall ensure compliance with Federal, state, and local regulations applicable to the handling and transportation of hazardous materials on public highways. The transportation agent or agency (commercial or government) shall be properly authorized to transport hazardous material/waste. To prepare spent batteries for shipment, regardless of which disposal method is used, they must be properly labeled as a corrosive and specially packaged in DOT approved containers. However, they can be packaged the same way as when received new (i.e. in plastic bags, sealed, palletized, and banded) provided: (1) no other hazardous material/waste is transported in the same vehicle, (2) they are separated from other materials, (3) the transport vehicle is carrying no material shipped by any person other than the shipper of the batteries, (4) buoy power units are packaged as stated below. Leaking batteries must be packaged in DOT - approved containers and properly labeled. These transportation requirements are found in 49 CFR 173.260. Spent batteries awaiting shipment must be packaged as stated above as soon as possible to satisfy EPA requirements and protect them from rain.

•Handling of Batteries

1. Plastic containment bags - - Batteries (except those in buoy power units) are shipped in heavy plastic bags furnished by the manufacturer. The batteries shall

remain in the plastic bags during service life and during storage and transport to the disposal site.

2. Buoy power units - - Because of configuration and weight, buoy power units present additional handling problems. Upon removal of the expended power unit from a buoy, the steel or wooden pocket adapters should be removed from the base of the pack and the power assembly clamp removed from the top. The power unit should be draped with heavy gauge sheet polyethylene and the lifting eye replaced; it should then be placed bottom first into a heavy-duty polyethylene drum liner. The draped sheet should be tucked into the liner and secured with several round turns of tape.

3. Batteries must always be handled and stored in the vertical position.

•Personnel Safety

1. Face and eye protection - - Certain safety precautions should be observed by personnel handling newly activated, activated, or expended batteries. Expended air cell batteries are most likely to have developed leaks and are, therefore, more hazardous. It is mandatory that personnel handling expended air cell batteries wear eye protection (full face shields are preferred) and rubber gloves.

2. Treatment for electrolyte burns - - Potassium hydroxide electrolyte is an extremely strong alkaline solution and not an acid. If the alkali comes in contact with the skin, the exposed area should be washed immediately with freely running cold water for at least 5 min to dilute and wash away the caustic solution. Compresses of vinegar, lemon juice, boric acid, or 5 percent acetic acid solution may be used. Eyes should be washed thoroughly but gently with plenty of cold water until professional medical attention can be obtained. Neutralizing solutions should not be placed in the eyes.

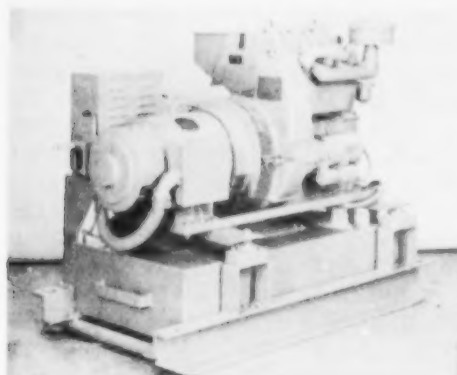
Secondary Battery Systems. Secondary batteries shall be serviced as indicated below and as recommended by battery manufacturer's instructions. Also, at each service visit, ensure that the battery charger is set at the required output voltage with the batteries fully charged and that batteries are positioned level with no uncovered plates. Annually, or immediately following a deep discharge cycle, equalize charge all secondary batteries.

Lead Acid Batteries. At each service visit, measure specific gravity to determine the state of charge and check

electrolyte level. Correct low electrolyte by adding distilled water.

Nickel-Cadmium Batteries. Check electrolyte level at each service visit. Add distilled battery water as required. Measure specific gravity annually to determine the condition of the electrolyte. Although *not* an indication of the state of charge, specific gravity must be maintained within limits to ensure satisfactory battery operation. Correct as needed to the required limits by strict adherence to battery manufacturer's instructions.

D. GENERAL DESCRIPTION DATA SHEETS
STANDARD HIGH-ENDURANCE ENGINE-GENERATOR



Function. Standard high-endurance engine-generators provide unattended prime or standby power on Category I aids and are installed in specially built fiberglass containers or in standard volumes fabricated inside structures.

Features

- Available in 6.5- and 10-kW capacities, fully assembled on a skid base
- Capable of 90-day unattended operation
- Solid-state voltage regulation to ± 1 percent (steady state--no load to full load)
- Frequency regulation to ± 3 percent (steady state--no load to full load)
- Air cooled by a crankshaft-driven fan
- Manual start capability with hand-crank and compression release
- Military standard electrical receptacles in electrical panel for power output and control connections
- Oil pressure gauge
- Nominal 6-ft fuel lift capability with engine-mounted diaphragm fuel transfer/supply pump
- Voltmeter
- Frequency meter
- Elapsed time indicator
- Low oil pressure and high oil temperature safety trip sensors
- Circuit breaker (150 A) between generator output and power output connector.

Electrical and Mechanical Characteristics

	6.5 kW	10.0 kW
Number of cylinders	2	3
Brake horsepower	12	18
Speed (rpm)	1,800	1,800
kVA	8.1	12.5
Power factor	.8	.8
Hertz	60	60
Phase	single	single
Voltage	120	120

Dimensions and Weight

	6.5 kW	10.0 kW
Total dry weight (lb)	1,275	1,410
Length (in.)	55	55
Height (in.)	45	45
Width (in.)	30	30

Related Equipment. The following equipment is supplied with the standard high-endurance engine-generator:

- complete ready-to-run engine-generator unit (after making fuel, electrical, exhaust, and any ventilation connections)
- lifting fixture for single point lift
- exhaust pipe flexible connection and muffler
- one combination filter/coalescer/separator unit for remote mounting.

Data Sheet 9-D(1). Standard high-endurance engine-generator.

Related Equipment (cont'd)

Related Equipment (cont'd). Other equipment required, but not supplied, is listed below:

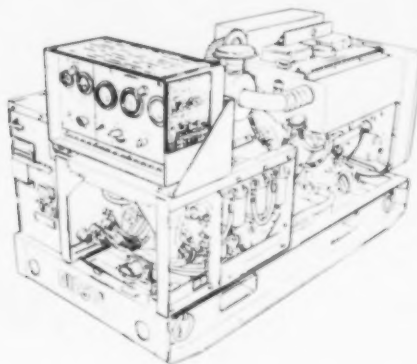
- standard automatic power system controller
- 24 V starting batteries and cables
- 24 V battery charger
- fuel daytank assembly (where required by main fuel supply location)
- environmental control unit.

Connections required but not supplied are:

- fuel piping
- exhaust piping (additional)
- electrical power cables (fitted with end plugs).

Additional Data. Standard high-endurance engine-generator units are available from Commandant (G-EOE) and shall be included in the STRUCTALT as part of an automation or modernization request.

STANDARD EMERGENCY PORTABLE ENGINE-GENERATOR



Function. The emergency portable engine-generator can be used to power any aid that suffers a loss of primary and backup power and cannot be temporarily powered with primary batteries.

Features

- Available in 5- and 10-kW capacities, fully assembled on a skid base
- Designed and built for exposed weather operation
- Capable of 90-day unattended operation (with an installed lube oil extender kit)
- Solid-state voltage regulation to ± 3 percent (steady state--no load to full load)
- Frequency regulation to ± 3 percent (steady state--no load to full load)
- Electric fuel pumps with a nominal lift capacity of 8 ft together with an installed fuel filter and strainer
- Auxiliary fuel pump for suction from remote source
- Thermostatically controlled air cooling by a crankshaft-driven fan
- Complete electrical system including starting battery, battery charger, and 104 A ac circuit breaker
- Instrumentation and controls include battery indicator, hour meter, frequency meter, percent-rated-current meter, voltmeter, engine oil pressure gauge, voltage adjusting rheostat, ammeter/voltmeter transfer switch, and master run/stop switch.

Electrical and Mechanical Characteristics

	5.0 kW	10.0 kW
Number of cylinders	2	4
Brake horsepower	8.9	16.0
Speed (rpm)	1,800	1,800
kVA	6.25	12.5
Power factor	.8	.8
Hertz	60	60
Phase	single	single
Voltage	120	120

Dimensions and Weight

	5.0 kW	10.0 kW
Total dry weight (lb)	960	1,220
Length (in.)	51	62
Height (in.)	37	37
Width (in.)	32	32

Related Equipment. The two items listed below are required but not supplied:

- fuel line (5/16-in. tubing or hose) from supply source
- electrical power cables.

Additional Data. The standard emergency portable engine-generator unit is manufactured by Onan Corporation, 1400 73rd Avenue NE, Minneapolis, Minnesota 55432 (contract no. F04606-74-C-1133). The units are available from Commandant (G-EOE). Consult Commandant (G-EOE) for lube oil extender kits to extend unattended operation to 90 days.

STANDARD ENVIRONMENTAL CONTROL UNIT



Intake Unit



Exhaust Unit

Function. The standard environmental control unit is used with the standard high-endurance engine-generators to filter and temper outside air with warm air inside the prime power shelter or standard volume and to discharge heated air from the space.

Features

- Thermostatically controlled damper system capable of maintaining an inside temperature of 70°F with an outside ambient temperature between -40°F and 60°F (above 60°F, the system will maintain the inside temperature to within +10°F of the outside ambient temperature)
- Modulating type low-voltage ac electric damper motors controlled by proportioning thermostats in both intake and exhaust units
- Inertial intake air filter removes minute solid particles
- Stainless steel construction.

Electrical Characteristics

Blower motor voltage	120 Vac
Modutrol motor voltage	24 Vac

Dimensions and Weight

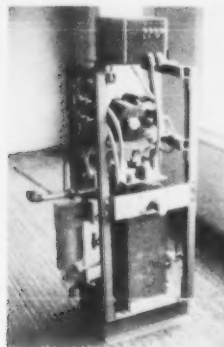
	Intake Unit	Exhaust Unit	Intake Hood	Exhaust Hood
Weight (lb)	475	190	65	55
Width (in.)	64.5	30.8	28.5	24.5
Height (in.)	40.5	21.0	35.5	21.5
Depth	28.5	30.0	28.5	19.75

Related Equipment. The following connections are required but not supplied:

- electrical power supply, 7.5 A at 120 Vac
- ducting (8- by 16-in. galvanized sheet steel) to connect with engine-generators.

Additional Data. Component part information can be found on standard aids to navigation Drawing Nos. 130902-1 (sheets 1 and 2), 130902-2, and 130902-3, available from Commandant (G-EOE). Environmental control units are available from Commandant (G-EOE) and shall be included in the STRUCTALT as part of the automation or modernization request.

STANDARD FUEL DAYTANK ASSEMBLY



Function. The standard fuel daytank assembly supplies fuel to standard high-endurance engine-generators in locations where the combination of gravity and friction head loss exceeds the lift capacity of the standard high-endurance engine-mounted fuel pump (6 ft).

Features

- Two 2-gal/min pumps with automatic sequencing
- Stainless steel 8-gal tank (5-min fill time)
- Handpump for use during power loss and initial filling
- Two in-line solenoid suction valves on each pump provide daytank shutoff protection
- Combination fuel filter/separator prevents passage of water or solid particles down to 2 μ m in size
- Fully assembled on a metal frame.

Electrical Characteristics

Pumps	120 Vac, 60 Hz, 7 A
Controls and indicator lights	24 Vdc, 6 A

Dimensions and Weight

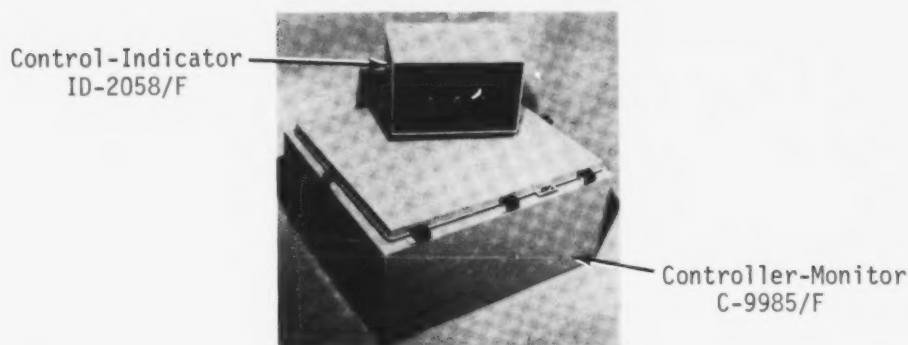
Total dry weight (lb)	270
Height (in.)	58
Width, less filter (in.)	18
Depth (in.)	15

Related Equipment. In addition to electrical power, the following connections are required but not supplied:

- copper fuel piping (1/2-in. minimum) from the main supply tank to the day-tank filter inlet
- fuel overflow piping (1-in. minimum) from the daytank to the main supply tank
- copper fuel supply and return piping (5/16-in. minimum) between the daytank and the engine.

Additional Data. Component part information is shown on standard aids to navigation Drawing No. 130901 (sheets 1 and 2), available from Commandant (G-EOE). Standard fuel daytank assemblies are available from Commandant (G-EOE) and shall be included in the STRUCTALT as part of the automation or modernization request if required.

AUTOMATIC POWER SYSTEM CONTROLLER



Function. The automatic power system controller controls power to Category I aids with two power sources (either commercial power with a standard high-endurance standby engine-generator set or two standard high-endurance engine-generator sets). The controller monitors ac output voltage, frequency, lube oil pressure, and lube oil temperature, and automatically energizes, warms up, and connects the secondary engine-generator power source. It also provides a digital display of voltage or frequency and the mode of engine-generator failure.

Features

- Complementary metal oxide semiconductor (CMOS) digital circuitry
- Military grade components and connectors
- Secondary engine-generator automatic exercise cycle (local manual or remote initiation)
- Contacts for remote monitoring of power system
- Circuitry for automatic power system shutdown in the event of fire.

Electrical Characteristics

Power handling capability (maximum)	48 kVA at 480 Vac
Solenoid drive capability	10 A, ac or dc, 120 V maximum
Power input	24 Vdc ± 20 percent, 20 W

Standby current drain	240 mW maximum
Temperature range	-40°C to 65°C
Accuracy (measurement)	± 1 percent voltage and frequency

Dimensions and Weight

	Controller-Monitor	Control-Indicator
Weight (lb)	110	8
Height (in.)	26-1/2	9
Width (in.)	21	11-1/2
Depth (in.)	11-1/2	8-1/8

Related Equipment. Electrical cables listed below are required but not supplied:

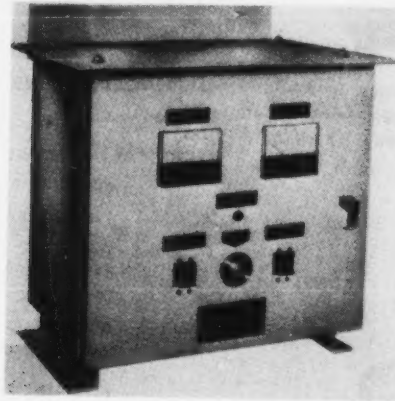
- controller-monitor to control-indicator
- power source to controller-monitor
- controller-monitor to 24 V power
- controller-monitor to remote control and monitoring system and fire extinguishing system (as applicable).

Additional Data. Soncraft, Inc., 8859 So. Greenwood, Chicago, Illinois 60619, manufactures the automatic power system controller. It should be ordered directly from E/GICP-APA stock as itemized below:

C-9985/F controller-monitor, CG-6115-01-GL7-2891
ID-2058/F control-indicator, CG-6115-01-GL7-2892

Data Sheet 9-D(5). Automatic power system controller.

24 V BATTERY CHARGER, MODEL CDSA-IBC 24-20A



Function. The 24 V battery charger is used for charging nickel-cadmium batteries on Category I aids to navigation where the batteries are used to start standard high-endurance engine-generators.

Features

- Solid-state components for full float service
- EMI interference suppression
- Temperature-compensated output using remote temperature sensors
- Adjustable float and equalize voltages
- Equalizing charge timer (24 hr)
- Short circuit protection (circuit breakers)
- Automatic current limiting
- Built-in transient protection
- NEMA type 2 enclosure construction
- DC voltmeter and ammeter.

Electrical Characteristics

Input	115 Vac ± 10 percent or 230 Vac ± 10 percent at 60 Hz ± 5 percent
Output voltage	20 to 32 Vdc
DC output current	11 A nominal, 14 A maximum
Output ripple	1 percent (rms)
Meter accuracy	± 2 percent
Temperature range	-20°F to 120°F

Dimensions and Weight

Weight (lb)	65
Height (in.)	24
Width (in.)	20
Length (in.)	12

Additional Data. The manufacturer of the CDSA-IBC 24-20A battery charger is the Edison Battery Division of McGraw-Edison, 6410 West Ridge Road, Erie, Pennsylvania 16506. It should be ordered directly from E/GICP-APA stock (stock no. CG-6130-01-015-0829).

12-V BATTERY CHARGER

Function. The 12-V battery charger is used for charging nickel-cadmium batteries on Category I, II, and III aids to navigation where the batteries are required for emergency signal power, remote control and monitor system power, and other support system power.

Features

- Solid-state components for full float service
- EMI interference suppression
- Temperature - compensated output using remote temperature sensors
- Adjustable float and equalize voltages
- Automatic equalization charging cycle upon loss and restoration of ac input
- Short circuit protection (circuit breakers)
- Automatic current limiting
- DC voltmeter and ammeter

Electrical Characteristics

Input	115 Vac ± 10 percent at 60 Hz ± 5 percent
Output	12 to 15 Vdc
DC output current	Individual engineered
Output ripple	± 0.5 percent (rms)
Temperature range	-20°F to 120°F
Battery drain by charger	< 25 mAdc
Meter accuracy	± 2 percent

Additional Data. There are no Commandant (G-EOE) standard battery chargers for these applications available for issue. Equipment previously stocked which remains in use is the McGraw-Edison model CDSA-IBC 12-30A battery charger. The Astra Products model CDZE-1201234 battery charger was also previously stocked but has been removed from service. Until new procurement is complete, the interim battery charger to be installed shall be the La Marche Model A-11-P-30-12V with the following accessories: AC and DC circuit breakers, AC pilot light and 0-24 hour equalization timer. Order direct from the factory: La Marche Manufacturing Company, 106 Braddock Drive, Des Plaines, Illinois 60018 allowing 6-10 weeks for delivery. Purchase order should state number and type of cells. Ensure that installation and servicing information is provided with the equipment.

BATTERY CHARGERS

Function. Battery chargers, as described on this data sheet, are used to charge nickel-cadmium or lead-acid batteries for standby power applications on Category IV aids.

Features

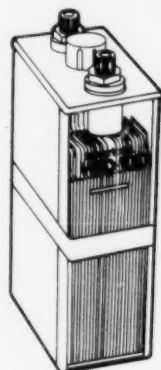
- Full float design with integral current limiting
- Temperature-compensated output
- Adjustable float and equalize voltages
- Equalizing charge timer (24 hr)
- Short circuit protection (circuit breakers)
- Built-in transient protection
- DC voltmeter and ammeter
- Temperature range from -20°F to 140°F.

Electrical Characteristics

Input	115 Vac ± 10 percent at 60 Hz ± 5 percent
Output voltage	12 to 15 Vdc
DC output current	individually engineered
Output ripple	less than 2 percent (rms with no load connected)
Meter accuracy	± 2 percent

Additional Data. There are no Commandant (G-EOE) standard battery chargers for these applications. Procure commercially available chargers with features and characteristics described above. Ensure that installation and servicing information is provided with the equipment. (A LaMarche Co. model A11-P [filtered output] charger of the required capacity and with the optional equipment necessary to meet the above requirements is satisfactory for aids to navigation use.)

NICKEL-CADMIUM STORAGE BATTERY (HED-100)



Function. The HED-100 nickel-cadmium storage battery with pocket-type plates is used connected in series of 20 cells to supply 24 Vdc to start engine-generators on Category I aids where high-endurance engine-generator sets are installed.

Features

- Preactivated and fully charged prior to shipment
- Transparent plastic case
- Quick connect multicell assembly
- Stud-type positive and negative cell terminals and bus bars
- Low freezing point potassium hydroxide electrolyte.

Electrical Characteristics

Output voltage	1.2 V per cell (nominal)
Capacity at 8-hr rate to 1.10 V per cell at 77°F	100 Ah

Equalize charge voltage (at 77°F)	30 V
Float charge voltage (at 77°F)	28 V

Dimensions and Weight

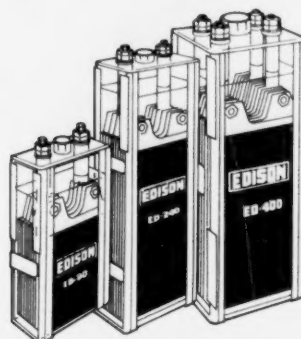
Weight (lb)	21
Height (in.)	14-5/16
Width (in.)	5-4/5
Length (in.)	3-11/16

Related Equipment. The 24 V battery charger is required (see Data Sheet 9-D(6)).

Additional Data. The HED-100 nickel-cadmium storage battery is manufactured by the Edison Battery Division of McGraw-Edison, P.O. Box 28, Bloomfield, New Jersey 07003. It should be ordered directly from the manufacturer on the latest term contract. Copies of the term contract are available from E/GICP (NSN CG 6140-01-GG0-0546).

Data Sheet 9-D(9). Nickel-cadmium storage battery (HED-100) ("pocket" plate construction).

NICKEL-CADMIUM STORAGE BATTERY (ED-80, ED-240, AND ED-400)



Function. The ED series nickel-cadmium storage batteries with pocket-type plates are used connected in series of 10 cells to supply 12 Vdc to electronic and emergency signal equipment aboard Category I, II, and III aids to navigation during periods of ac power loss.

Features

- Preactivated and fully charged prior to shipment
- Transparent plastic case
- Quick connect multicell assembly
- Stud type positive and negative cell terminals and bus bars
- Excellent low temperature operation
- Low freezing point potassium hydroxide electrolyte.

Electrical Characteristics

Output voltage	1.2 V per cell (nominal)
Capacity at 8-hr discharge rate to 1.10 V per cell at 77°F	ED-80 80 Ah ED-240 240 Ah ED-400 400 Ah
Equalize charge voltage (at 77°F)*	15 V
Float charge voltage (at 77°F)*	14 V

Dimensions and Weight

	ED-80	ED-240	ED-400
Weight (lb)	13	30	46
Height (in.)	12-1/4	18-1/4	18-1/4
Width (in.)	6-3/8	6-3/8	6-3/8
Length (in.)	3-3/8	4-11/16	6-3/4

Related Equipment. The 12 V battery charger is required (see Data Sheet 9-D(7)).

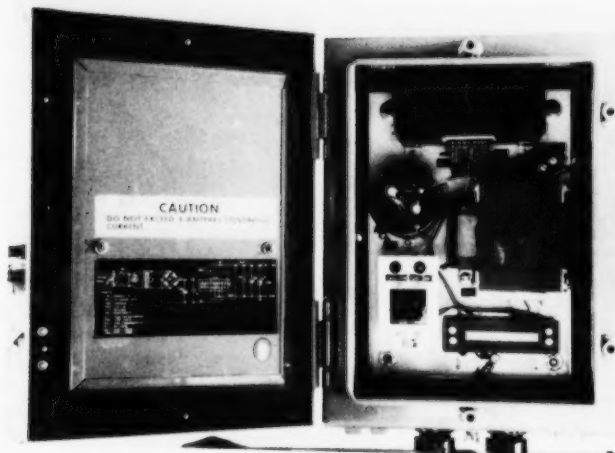
Additional Data. The manufacturer of the ED series storage batteries is the Edison Battery Division of McGraw-Edison, P.O. Box 28, Bloomfield, New Jersey 07003. They should be ordered directly from the manufacturer on the latest term contract, available from E/GICP. Use the following stock numbers:

ED-80	CG-6135-01-GGO-0086
ED-240	CG-6135-01-GGO-0087
ED-400	CG-6135-01-GGO-0088.

*Refer to battery charger technical manual for proper voltage settings at different temperatures.

Data Sheet 9-D(10). Nickel-cadmium storage battery (ED-80, ED-240, and ED-400).

GCF-RWL-2423 POWER SUPPLY, ATON



Function. The power supply converts 120VAC power to 12VDC power for use by DC powered aids to navigation equipment.

Features.

- Contained in a lockable NEMA Type 4 weather-proof cabinet
- Hinged front access door
- Parts mounted on a removable panel for easy access
- Locations of major parts silk-screened on the removable panel
- Watertight stuffing tubes at cable entries
- Operates in temperature range -20°C to 60°C at up to 95% humidity.
- Separate AC on and DC on indicators
- An AC input circuit breaker provides resettable circuit protection
- Input and output surge protection.

Electrical Characteristics.

Input: 95-130VAC, 60Hz
Surge protection to 3000V
Idle current less than 150 mA with no load.

Output: 13.5 ± 0.5VDC from 0 to 4 amps
AC ripple less than 0.3 volts peak to peak
Surge protection to 30 V
Surge current to 20 amp for 20 msec duration.

Dimensions and Weight.

Weight (lb) 59
Height (in) 16
Width (in) 12
Depth (in) 7.5

Related Equipment. The power supply can power the following aids to navigation equipment:

- (a) CG-181 Flasher with Lamp changer (.25 to 3.05 amp lamps)
- (b) FA-232 fog signal
- (c) SA-850 fog signal
- (d) Dual fog signal
- (e) Fog detector

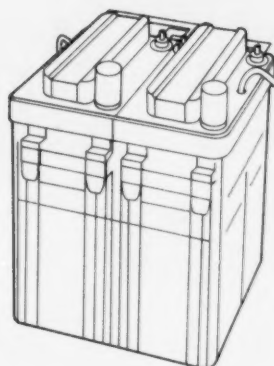
A manual, Instruction Booklet for GCF-RWL-2423 Aton Power Supply, is issued with the equipment. Additional copies are available from SUPCEN Brooklyn, stock no. CG7610-10-GE9-4501.

A Maintenance Support Outline is available and may be obtained from Commandant (G-EOE). The power supply is a field repairable item. Parts are available through the SUPCEN Brooklyn Supply Fund.

The power supply's stock number is CG5825-10-GL7-3381.

Data Sheet 9-D(11). 12 Vdc power supply.

MCGRW-EDISON AIR-DEPOLARIZED PRIMARY BATTERY (2S10A, 2S10F)



Function. The 2S10 air-depolarized batteries are used connected in series of five to supply 12.5 Vdc at 1000 Ah to fixed aids to navigation. The 2S10F user-activated battery is ordered in place of the 2S10A preactivated battery due to liquid electrolyte shipping restrictions only.

Features

- Two series connected cells
- Transparent plastic case
- Carbon dust cover with filter
- Maximum 1-yr shelf life
- Maximum 3-yr service life
- Stud type 3/16-in. positive and negative cell terminals with lockwashers.

Electrical Characteristics

Output voltage	1.25 V per cell
Capacity	1000 Ah per cell

Maximum continuous load

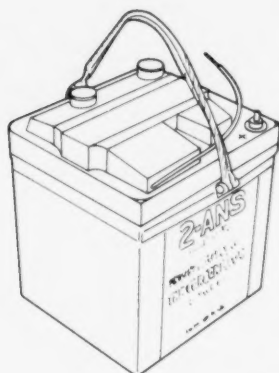
(at 70°F)	1.25 A
(at 25°F)	0.75 A
(at 0°F)	0.50 A

Dimensions and Weight

	<u>2S10A</u>	<u>2S10F</u>
Weight (lb)	30	20 (dry)
Height (in.)	10-5/8	10-5/8
Width (in.)	7-7/8	7-7/8
Length (in.)	8-5/8	8-5/8
Water to fill	--	9 pt

Additional Data. The 2S10 air-depolarized battery is manufactured by the Edison Battery Division of McGraw-Edison, P.O. Box 28, Bloomfield, New Jersey 07003. It is to be ordered directly from the manufacturer on the latest term contract, copies of which are available from E/GICP (2S10A, NSN CG-6135-00-170-4798; 2S10F, NSN CG-6135-00-087-3559).

SAFT AIR-DEPOLARIZED PRIMARY BATTERY (2S10F)



Function. The 2S10F air-depolarized battery is used connected in series of five to supply 12.5 Vdc at 1000 Ah to fixed aids to navigation.

Maximum continuous load

(at 70°F)	1.20 A
(at 25°F)	0.65 A
(at 0°F)	0.40 A

Features

- Two series connected cells
- Shipped dry, activated by adding potable water
- Clear plastic dust shield
- Maximum 1-yr shelf life
- Maximum 3-yr service life.

Dimensions and Weight

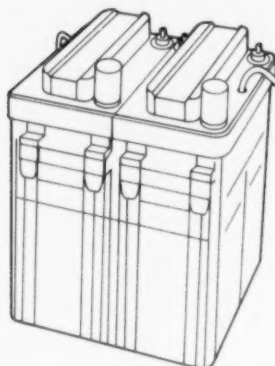
Weight (lb)	23-1/2
Height (in.)	9
Width (in.)	7-1/2
Length (in.)	8-7/16
Water to fill	7 pt

Electrical Characteristics

Output voltage	1.25 V per cell
Capacity	1000 Ah per cell

Additional Data. The Saft Corporation (formerly Carbone), 400 Myrtle Avenue, Boonton, New Jersey 07005, is the manufacturer of this battery. It should be ordered directly from the manufacturer on the latest term contract, copies of which are available from E/GICP (NSN CG-6135-00-G00-3776).

MCGRAW-EDISON AIR-DEPOLARIZED PRIMARY BATTERY (2S20A, 2S20F)



Function. The 2S20 air-depolarized batteries are used connected in series of 10 to supply 12.5 Vdc at 2000 Ah to fixed aids to navigation. The 2S20F user-activated battery is ordered in place of the 2S20A preactivated battery due to liquid electrolyte shipping restrictions only.

Features

- Two parallel connected cells
- Transparent plastic case
- Carbon dust cover with filter
- Maximum 1-yr shelf life
- Maximum 3-yr service life
- Stud type 3/16-in. positive and negative terminal posts.

Electrical Characteristics

Output voltage	1.25 V per cell
Capacity	2000 Ah per two-cell battery

Maximum continuous
load (at 70°F)
(at 25°F)
(at 0°F)

2.5 A
1.5 A
1.0 A

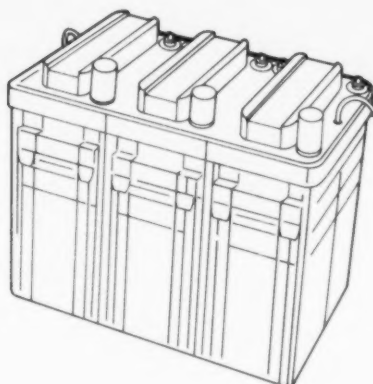
Dimensions and Weight

	2S20A	2S20F
Weight (lb)	30	20 (dry)
Height (in.)	10-5/8	10-5/8
Width (in.)	7-7/8	7-7/8
Length (in.)	8-5/8	8-5/8
Water to fill	--	9 pt

Additional Data. The 2S20 air-depolarized battery is manufactured by the Edison Battery Division of McGraw-Edison, P.O. Box 28, Bloomfield, New Jersey 07003. It should be ordered directly from the manufacturer on the latest term contract, copies of which are available from E/GICP (2S20A, NSN CG-6135-01-GGO-0620; 2S20F, NSN CG-6135-01-GGO-0621).

Data Sheet 9-D(14). McGraw-Edison air-depolarized primary battery (2S20A, 2S20F).

MCGRAW-EDISON AIR-DEPOLARIZED PRIMARY BATTERY (3S30A, 3S30F)



Function. The 3S30 air-depolarized batteries are used connected in series of 10 to supply 12.5 V at 3000 Ah to fixed aids to navigation. The 3S30F user-activated battery is ordered in place of the 3S30A preactivated battery due to liquid electrolyte shipping restrictions only.

Features

- Three parallel connected cells
- Transparent plastic case
- Carbon dust cover with filter
- Maximum 1-yr shelf life
- Maximum 3-yr service life
- Stud type 3/16-in. positive and negative cell terminal posts.

Electrical Characteristics

Output voltage	1.25 V per cell
Capacity	3000 Ah per cell

Maximum continuous load
(at 70°F)
(at 25°F)
(at 0°F)

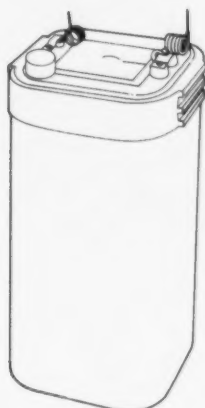
3.75 A
2.25 A
1.50 A

Dimensions and Weight

	3S30A	3S30F
Weight (lb)	48	33-1/4 (dry)
Height (in.)	10-5/8	10-5/8
Width (in.)	7-7/8	7-7/8
Length (in.)	12-3/4	12-3/4
Water to fill	--	13-1/2 pt

Additional Data. The 3S30 air-depolarized battery is manufactured by the Edison Battery Division of McGraw-Edison, P.O. Box 28, Bloomfield, New Jersey 07003. It is to be ordered from the manufacturer on the latest term contract, copies of which are available from E/GICP (3S30A, NSN CG-6135-01-GG0-0062; 3S30F, NSN CG-6135-01-GG0-0063).

MCGRAW-EDISON AIR-DEPOLARIZED PRIMARY BATTERY (1S30F)



Function. The 1S30F air-depolarized battery is used connected in series of 10 to supply 12.5 Vdc at 3000 Ah to fixed aids to navigation.

(at 70°F)
(at 25°F)
(at 0°F)

1.25 A
1.0 A
0.75 A

Features

- One cell
- Shipped dry, activated by adding potable water
- Maximum 1-yr shelf life
- Maximum 3-yr service life
- Tall square case saves space.

Dimension and Weight

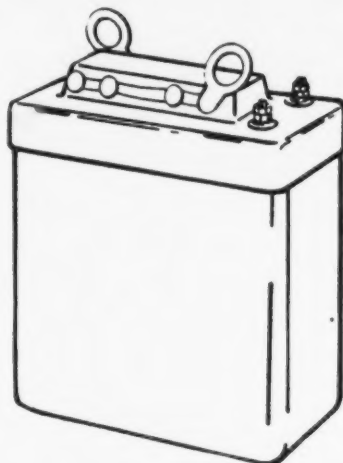
Weight (lb)	35-1/4 (dry)
Height (in.)	16-3/16
Width (in.)	7-9/16
Length (in.)	7-9/16
Water to fill	5 qt

Electrical Characteristics

Output voltage	1.25 V per cell
Capacity	3000 Ah per cell
Maximum continuous load	

Additional Data. The 1S30F battery is manufactured by the Edison Battery Division of McGraw-Edison, P.O. Box 28, Bloomfield, New Jersey 07003. It should be ordered directly from the manufacturer on the latest term contract, copies of which are available from E/GICP (NSN CG-6135-00-G00-4022).

SAFT AIR-DEPOLARIZED PRIMARY BATTERY (1S10D)



Function. The 1S10D primary air-depolarized battery is the basic cell that is used to make up all other Saft shore batteries and buoy power units.

Features.

- One cell
- Gelatinous electrolyte, shipped pre-activated

Electrical Characteristics.

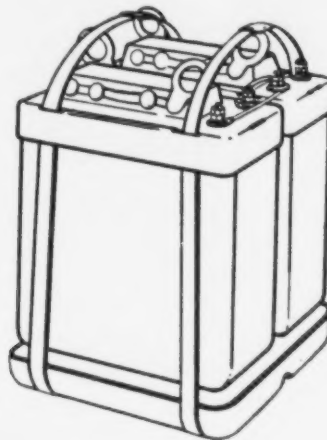
Output voltage	1.25V
Capacity	1000 Ah
Maximum Continuous load at 70F	1.0A

Dimensions and Weight.

Weight (lb.)	12
Height (in.)	8-3/8
Width (in.)	7-7/8
Length (in.)	4-1/4

Additional Data. The SAFT Corporation, 711 Industrial Boulevard, Valdosta, Georgia 31601 is the manufacturer of this battery. It should be ordered directly from the manufacturer on the latest term contract, copies of which are available from E/G-ICP. (NSN CG-6135-00-G00-3776).

SAFT AIR-DEPOLARIZED PRIMARY BATTERY (2S10D and 2S20D)



Function. The 2S10D primary air-depolarized battery is used connected in series of five to supply 12.5V at 1000 Ah to fixed aids to navigation. The 2S20D has two cells connected in parallel. Ten parallel-connected 2S20D batteries may be connected in series to provide 12.5V at 2000 Ah.

Features.

- Gelatinous electrolyte, shipped pre-activated

Electrical Characteristics.

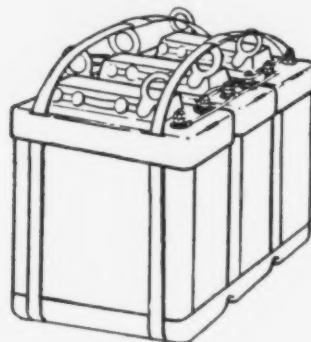
	2S10D	2S20D
Output voltage	2.5V	1.25V
Capacity	1000 Ah	2000 Ah
Maximum Continuous Load at 70F	1.0A	2.0A

Dimensions and Weight.

Weight (lb.)	23
Height (in.)	8-3/8
Width (in.)	7-7/8
Length (in.)	8-1/2

Additional Data. The SAFT Corporation, 711 Industrial Boulevard, Valdosta, Georgia 31601 is the manufacturer of this battery. It should be ordered directly from the manufacturer on the latest term contract, copies of which are available from E/G-ICP. (2S10D: NSN CG-6135-01-GL2-8997; 2S20D: NSN CG-6135-01-GL2-9000).

SAFT AIR-DEPOLARIZED PRIMARY BATTERY (3S10D and 3S30D)



Function. The 3S10D primary air-depolarized battery is used with 2S10D batteries connected in series combinations of 10 cells to provide 12.5V at 1000 Ah for fixed aids to navigation. The 3S30D consists of three cells connected in parallel. Ten parallel connected 3S30D batteries may be connected in series to provide 12.5V at 3000 Ah.

Features.

- Three series-connected cells (3S10D)
- Three parallel-connected cells (3S30D)
- Gelatinous electrolyte, shipped pre-activated

Electrical Characteristics.

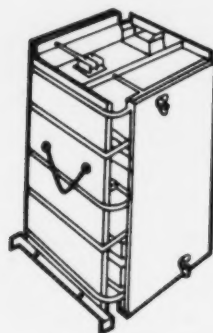
	3S10D	3S30D
Output Voltage	3.75V	11.25V
Capacity	1000 Ah	3000 Ah
Maximum Continuous Load at 70F	1.0A	3.0A

Dimensions and Weight.

Weight (lb.)	34
Height (in.)	8-3/8
Width (in.)	7-3/8
Length (in.)	12-3/4

Additional Data. The SAFT Corporation, 711 Industrial Boulevard, Valdosta, Georgia 31601 is the manufacturer of this battery. It should be ordered directly from the manufacturer on the latest term contract, copies of which are available from E/G-ICP (3S10D: NSN CG-6135-01-GL2-8998; 3S30D: NSN CG-6135-01-GL2-8999).

SAFT BUOY POWER UNIT (B10D)



Function. The B10D buoy power unit is a prewired 12.5V, 1000 Ah unit used to supply power to floating aids to navigation. It consists essentially of 10 1S10D cells in series.

Features.

- Positive and negative connections at top of rack
- Rack mounted lifting eye
- Rack mounted lifting strap
- Reversible rack mounted pocket spacers
- Removable sides for inspection
- Gelatinous electrolyte, shipped pre-activated

Electrical Characteristics.

Output Voltage 12.5V
Capacity 1000 Ah
Maximum Continuous
Load at 70F 1.0A

Dimensions and Weight.

Weight (lb.)	150
Height (in.)	33-7/8
Width (in.)	14-13/16
Length (in.)	17-1/2

Additional Data. The B10D power unit is manufactured by the SAFT Corporation, 711 Industrial Boulevard, Valdosta, Georgia 31601. They are to be ordered directly from the manufacturer on the latest term contract, copies of which are available from E/G-ICP (NSN CG-1635-01-GL2-9001).

SAFT BUOY POWER UNIT (B20D)



Function. The B20D buoy power unit is a 12.5V, 2000 Ah unit used to supply power to floating aids to navigation. It consists essentially of 10 2S20D batteries in series.

Features.

- Positive and negative connections on top of rack
- Rack mounted lifting eye
- Rack mounted lifting strap
- Reversible rack mounted pocket spacers
- Removable sides for inspection
- Gelatinous electrolyte, shipped pre-activated

Electrical Characteristics.

Output Voltage	12.5V
Capacity	2000 Ah
Maximum Continuous Load at 70F	2.0A

Dimensions and Weight.

Weight (lb.)	285
Height (in.)	61-7/8
Width (in.)	14-13/16
Length (in.)	17-1/2

Additional Data. The B20D power units are manufactured by the SAFT Corporation, 711 Industrial Boulevard, Valdosta, Georgia 31601. They are to be ordered directly from the manufacturer on the latest term contract, copies of which are available from E/G-ICP (NSN CG-6135-01-GL2-9002).

SAFT BUOY POWER UNIT (B30D)



Function. The B30D buoy power unit is a 12.5V, 3000 Ah unit used to supply power to floating aids to navigation. It consists essentially of 10 3S30D batteries in series.

Features.

- Positive and negative connections at top of rack
- Rack mounted lifting eye
- Rack mounted lifting strap
- Reversible rack mounted pocket spacers
- Removable sides for inspection
- Gelatinous electrolyte, shipped pre-activated

Electrical Characteristics.

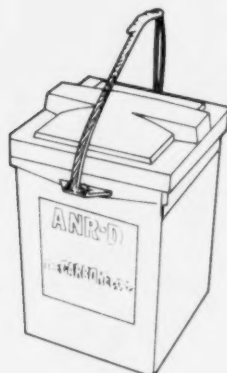
Output Voltage	12.5V
Capacity	3000 Ah
Maximum Continuous load at 70F	3.0A

Dimensions and Weight.

Weight (lb.)	416
Height (in.)	61-7/8
Width (in.)	14-13/16
Length (in.)	17-1/2

Additional Data. The B30D power unit is manufactured by the SAFT Corporation, 711 Industrial Boulevard, Valdosta, Georgia 31601. They should be ordered directly from the manufacturer on the latest term contract, copies of which are available from E/G-ICP (NSN CG-6135-01-GL2-9003).

SAFT AIR-DEPOLARIZED PRIMARY BATTERY (1S30 F)



Function. The 1S30F primary air-depolarized battery is used connected in series of 10 to supply 12.5 Vdc at 3000 Ah to fixed aids to navigation.

(at 70°F)	1.25 A
(at 25°F)	1.0 A
(at 0°F)	0.75 A

Features

- One cell
- Shipped dry, activated by adding potable water
- Maximum 1-yr shelf life
- Maximum 3-yr service life
- Tall square case saves space.

Electrical Characteristics

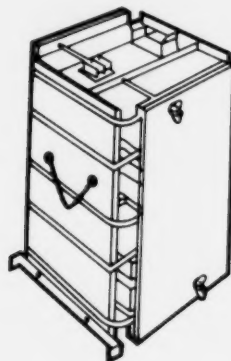
Output voltage	1.25 V per cell
Capacity	3000 Ah per cell
Maximum continuous load	

Dimensions and Weight

Weight (lb)	41 (dry)
Height (in.)	14-1/4
Width (in.)	8-5/16
Length (in.)	8-5/16
Water to fill	5-1/4 qt

Additional Data. This 1S30F primary air-depolarized battery is manufactured by the Saft Corporation (formerly Carbone), 400 Myrtle Avenue, Boonton, New Jersey 07005. It is to be ordered directly from the manufacturer on the latest term contract, copies of which are available from E/GICP (NSN CG-6135-00-G00-3778).

MCGRAW-EDISON BUOY POWER UNIT (B10A, B10F, B10RA)



Function. The B10 buoy power units are prewired 12.5 V, 1000 Ah units used to supply power to floating aids to navigation. The B10F power unit is ordered in place of the B10A or B10RA unit due to liquid electrolyte shipping restrictions only.

Features

- Positive and negative connections at top of rack
- Rack-mounted lifting eye
- Rack-mounted lifting strap
- Rack-mounted pocket spacers (reversible)
- Removable sides for ease of inspection
- May be ordered with reservoir tops (B10RA).

Electrical Characteristics

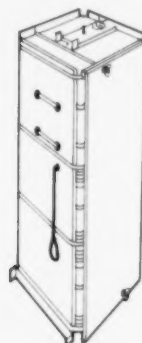
Output voltage	12.5 V
Capacity	1000 Ah
Maximum continuous load	
(at 70°F)	1.25 A
(at 25°F)	0.75 A
(at 0°F)	0.50 A

Dimensions and Weight

	B10A B10RA	B10F
Weight (lb)	215	163 (dry)
Height (in.)	33-7/8	33-7/8
Width (in.)	14-13/16	14-13/16
Length (in.)	17-1/3	17-1/3
Water to fill	--	4-1/2 pt per cell (22-1/2 qt)

Additional Data. The Edison Battery Division of McGraw-Edison, P.O. Box 28, Bloomfield, New Jersey 07003, manufactures the B10 power units. They should be ordered directly from the manufacturer on the latest term contract, copies of which are available from E/GICP (B10A, NSN CG-6135-00-170-4812 (preactivated); B10F, NSN CG-6135-00-170-4813 [shipped dry]; B10RA, NSN CG-6135-01-GG0-0078 [preactivated with reservoir top]).

MCGRAW-EDISON BUOY POWER UNIT (B20RA)



Function. The B20RA buoy power units are prewired 12.5 V, 2000 Ah units used to supply power to floating aids to navigation.

Maximum continuous load	
(at 70°F)	2.50 A
(at 25°F)	1.50 A
(at 0°F)	1.00 A

Features

- Positive and negative connections on top of rack
- Rack-mounted lifting eye
- Rack-mounted lifting strap
- Rack-mounted pocket spacers (reversible)
- Removable sides for ease of inspection
- Reservoir tops.

Dimensions and Weight

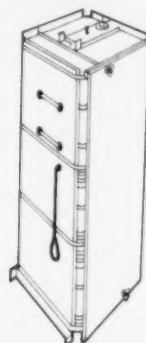
Weight (lb)	425
Height (in.)	61-7/8
Width (in.)	14-13/16
Length (in.)	17-1/2

Electrical Characteristics

Output voltage	12.5 V
Capacity	2000 Ah

Additional Data. The B20RA power units are manufactured by the Edison Battery Division of McGraw-Edison, P.O. Box 28, Bloomfield, New Jersey 07003. They are to be ordered directly from the manufacturer on the latest term contract, copies of which are available from E/GICP (NSN CG-6135-01-GG0-0622).

McGraw-Edison Buoy Power Unit (B30A, B30F, B30RA)



Function. The B30 buoy power units are prewired 12.5 V, 3000 Ah units used to supply power to floating aids to navigation. The B30F user-activated unit is ordered in place of the B30A or B30RA preactivated unit due to liquid electrolyte shipping restrictions only.

Features

- Positive and negative connections at top of rack
- Rack-mounted lifting eye
- Rack-mounted lifting strap on each side
- Rack-mounted pocket spacers (reversible)
- Removable sides for ease of inspection
- May be ordered with reservoir tops (B10RA).

Electrical Characteristics

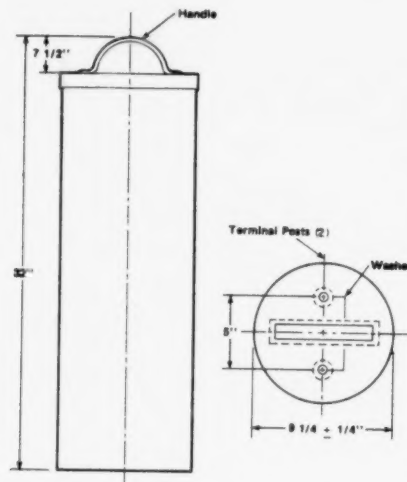
Output voltage	12.5 V
Capacity	3000 Ah
Maximum continuous load	
(at 70°F)	3.75 A
(at 25°F)	2.25 A
(at 9°F)	1.50 A

Dimensions and Weight

	B30A B30RA	B30F
Weight (lb)	508	435 (dry)
Height (in.)	61-7/8	61-7/8
Width (in.)	14-13/16	14-13/16
Length (in.)	17-1/2	17-1/2
Water to fill	--	4-1/2 pt per cell (67-1/2 qt total)

Additional Data. The B30 power units are manufactured by the Edison Battery Division of McGraw-Edison, P.O. Box 28, Bloomfield, New Jersey 07003. They are to be ordered directly from the manufacturer on the latest term contract, copies of which are available from E/GICP (B30A, NSN CG-6135-00-170-4821 [preactivated]; B30F, NSN CG-6135-00-170-4825 [shipped dry]; B30RA, NSN CG-6135-01-GG0-0077 [preactivated with reservoir top]).

DRY CELL ICE BUOY PRIMARY BATTERY (1B2.5 and 1B3.2)



Function. The 1B2.5 and 1B3.2 dry cell ice buoy batteries are prepackaged, prewired and sealed, to supply 12V to floating aids used to replace lighted buoys during the ice season.

Features.

- Positive and negative connections at top of canister
- Sealed steel canister
- No buoy pocket venting necessary
- Ready to use, no activation required
- Short shelf life

Electrical Characteristics.

Output Voltage 12V
Capacity 250 Ah and 320 Ah
to 11.0V at 70°F.

Maximum Continuous Load

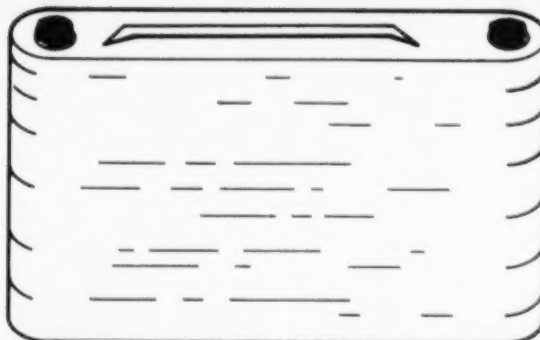
(at 70°F.)	1.0A
(at 25°F.)	.75A
(at 0°F.)	.40A

Dimensions and Weight.

Weight (lb.)	100
Height (in.)	32
Diameter (in.)	9-1/4

Additional Data. Union Carbide of Canada, 123 Eglinton Avenue East, Toronto, Canada M4P 1J3, has been the manufacturer of the ice buoy batteries. They should be ordered on MILSTRIP from E/G-ICP (ACN CG-6135-01-097-0045 for 250 Ah; ACN CG-6135-01-106-5542 for 320 Ah).

EMERGENCY POWER DRY CELL BATTERY (EO.3)



Function. The EO.3 emergency power dry cell battery is used connected in series of three to supply an initial 18 V for aids to navigation that cannot be properly serviced immediately.

Features

- Positive and negative connections at top of battery
- Sealed steel case
- No venting necessary
- Ready to use, no activation required.

Electrical Characteristics

Output voltage	6 V per battery (three required)
Capacity	25 to 30 Ah

Maximum continuous load

(at 120°F)	0.4 A
(at 70°F)	1.0 A
(at 25°F)	0.75 A
(at 0°F)	0.4 A

Dimensions and Weight

Weight (lb), each	11
Height (in.)	8-5/16
Width (in.)	2-11/16
Length (in.)	6-1/4

Additional Data. The EO.3 battery, available as model no. 1461, is manufactured by Union Carbide, 270 Park Avenue, New York, New York 10017, and should be ordered directly from GSA (NSN 6135-00-643-1307).

Bottom View

27"

1" Typ.

2" Typ. 4 Places

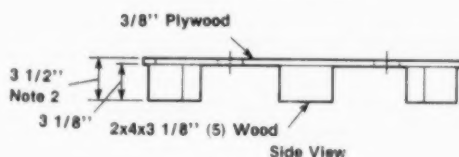
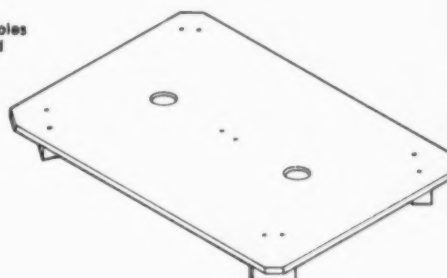
7" 7"

18 7/8"

45° Typ.

2" Dia. Holes
2 Required

See Note 1



Notes:
1. Legs to be mounted with water proof glue,
& 2 #8-32x3/4" Fl Hd Scw, Brass.
2. Tol: + 1/4"

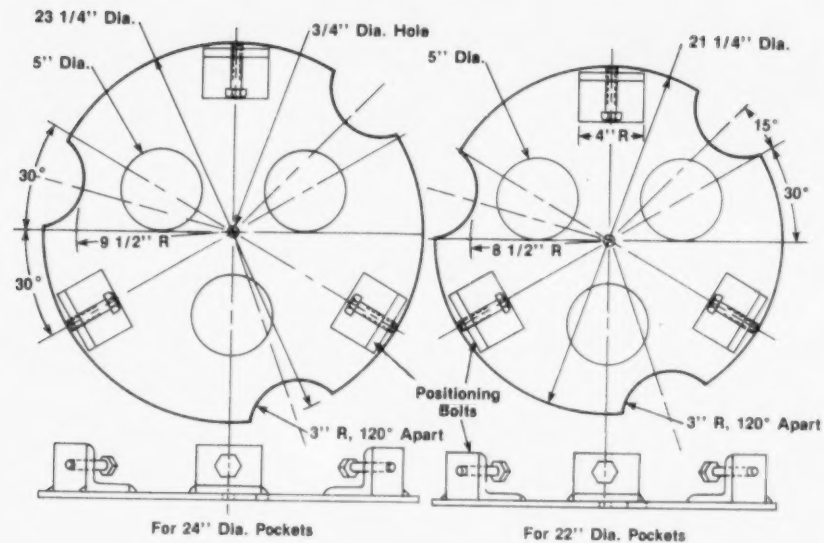
Features

- Plywood and 2- by 4-in. construction
- Ease of manufacture
- Two holes for handling.

Legs (in.)	5 each	3-1/2 X 2 X 4
Platform (in.)	1 each	3/8 X 18-7/8 X 27
Hole diameter	2 each	2
(in.)		

Additional Data. The platform is fabricated by units as needed. Its legs are mounted with waterproof glue and two #8-32 X 3/4-in. flat head brass screws.

BUOY POWER UNIT ASSEMBLY CLAMP



Function. The buoy power unit assembly clamp is attached to the top of buoy power units before installation in buoy pockets. After installation in the pocket, the clamp positioning bolts are tightened against the pocket walls to prevent movement inside the pocket which could damage the batteries.

Features

- Terminal board access hole
- Antirotation device engaging hole
- Heavy duty positioning bolts.

Dimensions

Plate diameter (in.)	21-1/4 or 23-1/4
Center hole diameter (in.)	3/4
Number and location of positioning bolts	3, 120° apart
Number, diameter, and location of access holes	3, 5 in. 120° apart

Additional Data. Positioning bolts are welded to the steel plate. The power unit assembly clamp is a standard item fabricated by CG industrial facilities per CG Drawing No. 107391, Rev. G.

LEAD ACID BATTERY
(Stationary)



Function. The lead acid battery with calcium plates is connected in series of six cells to supply 12 Vdc standby power to 12 Vdc signal equipment at Category IV aids where standby power is required.

Features

- Preactivated and fully charged prior to shipment
- Transparent plastic case
- Stud-type terminals with bus bar inter-cell connectors.

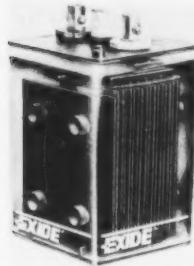
Electrical Characteristics

Output voltage (nominal)	2.0 V per cell
Capacity	as required for use
Float charge voltage	2.15 to 2.17 V per cell
Equalize charge voltage	2.33 V per cell

Related Equipment. A 12 V float type battery charger is required (see Data Sheet 9-D(8)).

Additional Data. The lead acid battery can be procured from the GSA schedule or through a manufacturer.

Lead Acid Battery
(Large Photovoltaic)



Function. These lead acid batteries are connected in series of six cells to supply 12 Vdc power to solar powered aids requiring 350 A.H. or more.

Features.

- o Transparent plastic case
- o Stud-type terminals
- o Available dry charged or charged wet
- o Sizes 390 - 1560 A.H.
- o Supplied with interconnecting cables

Electrical Characteristics

Output voltage (nominal)	2.0 V per cell	
Charge voltage	2.3 - 2.5 V per cell	
Self discharge rate	3.6% per month at 77°F	
Capacity -	TYPE	NOM. A.H. CAP.
	E1-5	390
	E1-7	585
	E1-9	780
	E1-11	975
	E1-13	1170
	E1-15	1365
	E1-17	1560

Related Equipment. Solar photovoltaic array CG-35W. Multi-Array Controller.

Additional Data. These lead acid battery can be procured from the GSA schedule or through the Exide Corporation.

CHAPTER 10

Solar Power System

A solar power system consists of solar panel(s), voltage regulator(s), rechargeable batteries and mounting hardware. The design parameters selected for the solar power systems are all on the conservative side and are based on the average amount of sunlight measured at various geographical areas over the last 20 years, taking into account seasonal periods of fog and rain. Many safety factors are included such as transmissivity losses caused by dirt or bird guano on the solar panel, the charging efficiency of the batteries and designing the system so that the batteries do not drop below 50% state-of-charge. In general, solar power systems can be designed to work wherever there is sunlight. From a practical matter there are circumstances where these systems should not be used. These are when, for instance, solar array and battery

size are physically too large because of little sunshine or shaded conditions or in high collision or vandal problem areas where expense is the consideration. The 3-1/2' x 8' buoys are too unstable to be powered by solar energy. Mid-channel buoys which will have topmarks after the IALA conversion and 5' x 11' buoys will not be considered for conversion now but with some minor modifications may be candidates in the future. The solar cells themselves are solid state devices and have very long lifetimes. Battery charge regulators are part of these systems as extra insurance to prolong battery life and decrease possible electrolyte replenishment requirements. The regulator design allows the solar array to act as a daylight control and contains components to prevent loss of battery charge caused by discharge back through the array at night.

A. Selection Guide

Component Selection

Solar Panels. Solar panels are photovoltaic devices that convert sunlight directly into electricity. The current generated by the solar panel during the day is used to charge a storage battery which powers the aid at night. Three sizes of panels are available: 10 Watt, 20 Watt and 35 Watt. The CG-234 Daylight Control is not needed on solar powered aids to navigation. The voltage regulator senses the various light levels on the solar panel to activate or deactivate the light. Manufacturers' test data sheets containing I-V curves of solar panels shall be maintained in the aids' permanent history files. Technical information on the solar panels to be used on aids to navigation is given on Data Sheet 10-D(1).

Voltage Regulators. The voltage regulator is a solid state device that prevents the battery from discharging through the panel(s) at night and provides a means for the solar panel to act as a daylight control. The voltage regulator will also switch from full charge to trickle charge to avoid excessive overcharging of the batteries. It is designed to fit inside standard lanterns on the CG-6P lampchanger mounting bracket above the CG-181 Flasher. Technical information on voltage regulators to be used on solar powered aids to navigation is given on data sheet 10-D(2).

Secondary Batteries.

o General Information. Secondary batteries are batteries that can be recharged. The batteries used with solar power systems look similar to automobile batteries, however, they should not be used in that capacity. Automobile batteries deliver large

amounts of current in short periods of time. Secondary batteries used for solar power applications are designed to provide small amounts of current over a long time. The two types of lead-acid secondary batteries to be used on solar powered aids to navigation are given below. Both batteries have a shelf life of one year.

1. Maintenance-free 12V batteries--These batteries must be used on all solar powered buoys and may be used on structures. Data Sheet 10-D(3) describes these batteries.

2. 6V batteries--These batteries may only be used on structures because their pure lead grids are subject to damage due to buoy motion and because they leak electrolyte in buoys. Two 6V batteries must be connected in series to power a 12V system. These batteries are excellent cold weather batteries and their use is highly recommended in areas where the temperature frequently drops below 10°F. Data Sheet 10-D(4) describes these batteries.

o Battery Chargers. Battery chargers that charge secondary batteries used for solar powered aids to navigation should have short circuit protection (circuit breakers), a DC ammeter and be capable of providing a minimum of 10 amps of DC output current at 12 to 15 Vdc. An equalizing charge timer may be desirable for units charging large numbers of batteries.

Mounting Hardware. Support hardware is needed to mount the solar panel to the aid and to orient the solar panel to receive maximum sunlight. For structures in the northern hemisphere the panel is oriented toward true south and tilted at angles (measured from the horizontal) governed by the

following locations: Alaska - 75°, Continental U.S. - 60°, Hawaii and GANTSEC - 30°. For buoys, the panel is mounted horizontally above the lantern because the buoy's orientation cannot be controlled. Battery racks are needed to accommodate the maintenance-free 12V batteries inside buoy battery pockets. Installation kits containing various bolts, nuts, bird springs, stuffing tubes and washers are stocked at Supply Center Brooklyn.

Solar Power System.

Standard Single Panel Designs.

Tables 10-1 through 10-21 are design tables for selecting single panel solar power systems for lighted minor aids to navigation in each district.

The appropriate solar panel and number of secondary batteries required for lighted aids with standard flasher characteristics can be found from these tables. Additional design tables have been included for geographic regions having significantly different climatic conditions than the rest of the district.

Multiple Panel/Non-standard Designs. Standard loads requiring multiple panels, non-standard loads, or combinations of loads (for example, a light with foghorn and racon), can be sized by using the solar design computer program "Solar-Calc". This computer program and its supporting documentation have been supplied to each District (oan) office.

Table 10-1

FIRST DISTRICT SOLAR SIZING TABLE

		TILT ANGLE											
B - BUOY	0°	LAMP SIZE											
S - STRUCTURE	60°												
FLASHER CHARACTERISTIC		.25A		.55A		.77A		1.15A		2.03A		3.05A	
		PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT
		WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS
FL4 (.4) or FL6 (.6)	B	10	100	10	100	20	100	20	200	35	300	-	-
	S	10	100	10	100	10	100	20	100	35	100	35	300
FL2.5 (.3)	B	10	100	20	100	20	100	35	100	35	600	-	-
	S	10	100	10	100	20	100	20	100	35	100	-	-
GP FL 6(2 + 1)	B	10	100	20	100	20	200	35	200	35	900	-	-
	S	10	100	10	100	20	100	20	200	35	300	-	-
GP FL5 (2x.4)	B	10	100	20	100	20	200	35	200	-	-	-	-
	S	10	100	10	100	20	100	20	200	35	300	-	-
MQFL (6x.3)	B	10	100	20	100	35	100	35	300	-	-	-	-
	S	10	100	20	100	20	100	35	100	35	500	-	-
QKFL 1.0 (.3) or MO (A) (.4, 2.0)	B	20	100	35	100	35	400	-	-	-	-	-	-
	S	10	100	20	100	35	100	35	300	-	-	-	-
GP FL6 (2x1.0)	B	20	100	35	100	35	400	-	-	-	-	-	-
	S	10	100	20	100	35	100	35	300	-	-	-	-
E16 (3.0)	B	20	200	35	400	35	800	-	-	-	-	-	-
	S	20	100	35	100	35	200	-	-	-	-	-	-
OCC4 (3.0)	B	35	200	-	-	-	-	-	-	-	-	-	-
	S	20	100	35	300	-	-	-	-	-	-	-	-
FIXED	B	35	300	-	-	-	-	-	-	-	-	-	-
	S	35	100	35	800	-	-	-	-	-	-	-	-

Table 10-2

SECOND DISTRICT (Middle and Lower Mississippi River) **SOLAR SIZING TABLE**

TRV
ANGLE

Reference Site: ST. Louis, MO

B - BUOY		LAMP SIZE											
S - STRUCTURE													
FLASHER CHARACTERISTIC		.25A		.55A		.77A		1.15A		2.03A		3.05A	
		PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT
		WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS
FL4 (.4) or FL8 (.6)	B	10	100	10	100	10	100	20	100	35	100	35	500
	S	10	100	10	100	10	100	10	100	20	100	35	100
FL2.5 (.3)	B	10	100	10	100	10	200	20	100	35	300	-	-
	S	10	100	10	100	10	100	20	100	20	200	-	-
GP FL 6(2 + 1)	B	10	100	10	200	20	100	35	100	35	500	-	-
	S	10	100	10	100	10	100	20	100	35	100	-	-
GP FL5 (2x.4)	B	10	100	10	200	20	100	35	100	35	500	-	-
	S	10	100	10	100	10	200	20	100	35	100	35	600
IQKFL (6x.3)	B	10	100	20	100	20	100	35	100	35	800	-	-
	S	10	100	10	100	20	100	20	100	35	100	-	-
QKFL 1.0 (.3) or MO (A) (.4, 2.0)	B	10	100	20	200	35	100	35	500	-	-	-	-
	S	10	100	20	100	20	100	35	100	-	-	-	-
GP FL8 (2x1.0)	B	10	100	20	200	35	100	35	500	-	-	-	-
	S	10	100	20	100	20	100	35	100	-	-	-	-
E18 (3.0)	B	20	100	35	100	35	400	-	-	-	-	-	-
	S	10	100	20	100	35	100	35	400	-	-	-	-
OCC4 (3.0)	B	20	200	35	600	-	-	-	-	-	-	-	-
	S	20	100	35	100	35	400	-	-	-	-	-	-
FIXED	B	35	100	35	1000	-	-	-	-	-	-	-	-
	S	20	100	35	300	-	-	-	-	-	-	-	-

Table 10-3

SECOND DISTRICT (Tennessee River) SOLAR SIZING TABLE

		Reference Site: Chattanooga, TN											
		LAMP SIZE											
FLASHER CHARACTERISTIC		.25A		.55A		.77A		1.15A		2.03A		3.05A	
		PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT
		WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS
FL4 (.4) or FL6 (.6)	B	10	100	10	100	10	100	20	100	35	100	35	400
	S	10	100	10	100	10	100	10	200	20	100	35	100
FL2.5 (.3)	B	10	100	10	100	20	100	20	100	35	200	-	-
	S	10	100	10	100	10	100	20	100	35	100	-	-
GP FL 6(2 + 1)	B	10	100	10	200	20	100	20	200	35	400	-	-
	S	10	100	10	100	10	200	20	100	35	100	-	-
GP FL5 (2x.4)	B	10	100	10	200	20	100	20	200	35	400	-	-
	S	10	100	10	100	10	200	20	100	35	100	-	-
IQKFL (6x.3)	B	10	100	10	200	20	100	35	100	35	700	-	-
	S	10	100	10	100	20	100	20	100	35	200	-	-
QKFL 1.0 (.3) or MO (A) (.4, 2.0)	B	10	100	20	200	35	100	35	500	-	-	-	-
	S	10	100	20	100	20	100	35	100	-	-	-	-
GP FL6 (2x1.0)	B	10	100	20	200	35	100	35	400	-	-	-	-
	S	10	100	20	100	20	100	35	100	-	-	-	-
E16 (3.0)	B	20	100	35	100	35	400	-	-	-	-	-	-
	S	10	200	20	100	35	100	35	500	-	-	-	-
OCC4 (3.0)	B	20	200	35	500	-	-	-	-	-	-	-	-
	S	20	100	35	100	35	500	-	-	-	-	-	-
FIXED	B	35	100	35	800	-	-	-	-	-	-	-	-
	S	20	100	35	300	-	-	-	-	-	-	-	-

Table 10-4

SECOND DISTRICT (Upper Mississippi River) SOLAR SIZING TABLE

TILT
ANGLE

Reference Site: Minneapolis-ST Paul, MN

B - BUOY S - STRUCTURE		LAMP SIZE											
FLASHER CHARACTERISTIC		.25A		.55A		.77A		1.15A		2.03A		3.05A	
		PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT
		WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS
FL4 (.4) or FL8 (.6)	B	10	100	10	100	10	200	20	200	35	300	35	800
	S	10	100	10	100	10	100	20	100	20	200	35	200
FL2.5 (.3)	B	10	100	10	200	20	100	35	100	35	500	-	-
	S	10	100	10	100	10	100	20	100	35	100	-	-
GP FL 8(2 + 1)	B	10	100	20	100	20	200	35	200	35	800	-	-
	S	10	100	10	100	20	100	20	100	35	200	-	-
GP FL5 (2x.4)	B	10	100	20	100	20	200	35	200	-	-	-	-
	S	10	100	10	100	10	200	20	100	35	200	-	-
IQKFL (6x.3)	B	10	100	20	100	35	100	35	300	-	-	-	-
	S	10	100	10	200	20	100	20	200	35	400	-	-
QKFL 1.0 (.3) or MO (A) (.4, 2.0)	B	10	200	35	100	35	400	-	-	-	-	-	-
	S	10	100	20	100	35	100	35	200	-	-	-	-
GP FL6 (2x1.0)	B	10	200	35	100	35	400	35	800	-	-	-	-
	S	10	100	20	100	20	200	35	200	-	-	-	-
E16 (3.0)	B	20	200	35	400	35	800	-	-	-	-	-	-
	S	20	100	35	100	35	200	35	700	-	-	-	-
OCC4 (3.0)	B	35	100	-	-	-	-	-	-	-	-	-	-
	S	20	100	35	200	35	700	-	-	-	-	-	-
FIXED	B	35	300	-	-	-	-	-	-	-	-	-	-
	S	20	200	35	600	-	-	-	-	-	-	-	-

Table 10-5

SECOND DISTRICT (Missouri River)

SOLAR SIZING TABLE

TILT
ANGLE

Reference Site: North Omaha, NE

B — BUOY		LAMP SIZE											
S — STRUCTURE													
FLASHER CHARACTERISTIC		.25A		.55A		.77A		1.15A		2.03A		3.05A	
		PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT
		WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS
FL4 (.4) or FL8 (.8)	B	10	100	10	100	10	200	20	100	35	100	35	600
	S	10	100	10	100	10	100	10	100	20	100	35	100
FL2.5 (.3)	B	10	100	10	100	20	100	20	200	35	300	-	-
	S	10	100	10	100	10	100	20	100	20	200	-	-
GP FL 8(2 + 1)	B	10	100	10	200	20	100	35	100	35	600	-	-
	S	10	100	10	100	10	100	20	100	35	100	-	-
GP FL5 (2x.4)	B	10	100	10	200	20	100	35	100	35	600	-	-
	S	10	100	10	100	10	100	20	100	35	100	35	500
IQKFL (6x.3)	B	10	100	20	100	20	200	35	100	-	-	-	-
	S	10	100	10	100	10	200	20	100	35	100	-	-
QKFL 1.0 (.3) or MO (A) (.4, 2.0)	B	10	200	20	200	35	200	35	600	-	-	-	-
	S	10	100	20	100	20	100	35	100	-	-	-	-
GP FL8 (2x1.0)	B	10	200	20	200	35	100	35	600	-	-	-	-
	S	10	100	20	100	20	100	35	100	35	800	-	-
E18 (3.0)	B	20	100	35	200	35	500	-	-	-	-	-	-
	S	10	100	20	100	35	100	35	300	-	-	-	-
OCC4 (3.0)	B	35	100	35	600	-	-	-	-	-	-	-	-
	S	20	100	35	100	35	300	-	-	-	-	-	-
FIXED	B	35	100	-	-	-	-	-	-	-	-	-	-
	S	20	100	35	200	-	-	-	-	-	-	-	-

Table 10-6

SECOND DISTRICT (Ohio River) SOLAR SIZING TABLE

 TILT
ANGLE

Reference Site: Cincinnati, OH

B - BUOY		LAMP SIZE											
S - STRUCTURE													
FLASHER CHARACTERISTIC		.25A		.55A		.77A		1.15A		2.03A		3.05A	
		PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT
		WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS
FL4 (.4) or FL6 (.6)	B	10	100	10	100	10	200	20	100	35	200	35	700
	S	10	100	10	100	10	100	20	100	20	200	35	200
FL2.5 (.3)	B	10	100	10	200	20	100	20	200	35	400	-	-
	S	10	100	10	100	10	100	20	100	35	100	-	-
GP FL 6(2 + 1)	B	10	100	10	200	20	100	35	100	35	700	-	-
	S	10	100	10	100	20	100	20	100	35	200	-	-
GP FL5 (2x.4)	B	10	100	10	200	20	200	35	100	35	700	-	-
	S	10	100	10	100	20	100	20	100	35	200	-	-
IQKFL (6x.3)	B	10	100	20	100	20	200	35	200	-	-	-	-
	S	10	100	20	100	20	100	20	200	35	400	-	-
QKFL 1.0 (.3) or MO (A) (.4, 2.0)	B	10	200	35	100	35	300	35	700	-	-	-	-
	S	10	100	20	100	35	100	35	300	-	-	-	-
GP FL6 (2x1.0)	B	10	200	35	100	35	200	35	700	-	-	-	-
	S	10	100	20	100	35	100	35	200	-	-	-	-
E16 (3.0)	B	20	100	35	300	35	600	-	-	-	-	-	-
	S	20	100	35	100	35	200	35	800	-	-	-	-
OCC4 (3.0)	B	35	100	35	800	-	-	-	-	-	-	-	-
	S	20	100	35	300	35	800	-	-	-	-	-	-
FIXED	B	35	200	-	-	-	-	-	-	-	-	-	-
	S	20	200	35	700	-	-	-	-	-	-	-	-

Table 10-7

THIRD DISTRICT SOLAR SIZING TABLE

		TILT ANGLE											
B - BUOY		0°											
S - STRUCTURE		60°											
FLASHER CHARACTERISTIC		LAMP SIZE											
		.25A		.55A		.77A		1.15A		2.03A		3.05A	
		PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT
		WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS
FL4 (.4) or FL6 (.6)	B	10	100	10	100	20	100	20	200	35	200	35	800
	S	10	100	10	100	10	100	20	100	20	200	35	200
FL2.5 (.3)	B	10	100	20	100	20	100	20	200	35	400	-	-
	S	10	100	10	100	10	100	20	100	35	100	-	-
GP FL 6(2 + 1)	B	10	100	20	100	20	200	35	100	35	800	-	-
	S	10	100	10	100	20	100	20	100	35	200	-	-
GP FL5 (2x.4)	B	10	100	20	100	20	200	35	100	35	800	-	-
	S	10	100	10	100	20	100	20	100	35	200	-	-
IQKFL (6x.3)	B	10	100	20	100	20	200	35	200	-	-	-	-
	S	10	100	10	200	20	100	20	200	35	400	-	-
QKFL 1.0 (.3) or MO (A) (.4, 2.0)	B	20	100	35	100	35	300	35	800	-	-	-	-
	S	10	100	20	100	35	100	35	300	-	-	-	-
GP FL6 (2x1.0)	B	20	100	35	100	35	300	35	700	-	-	-	-
	S	10	100	20	100	35	100	35	200	-	-	-	-
E16 (3.0)	B	20	100	35	300	35	700	-	-	-	-	-	-
	S	20	100	35	100	35	200	-	-	-	-	-	-
OCC4 (3.0)	B	35	100	35	800	-	-	-	-	-	-	-	-
	S	20	100	35	300	-	-	-	-	-	-	-	-
FIXED	B	35	300	-	-	-	-	-	-	-	-	-	-
	S	35	100	35	700	-	-	-	-	-	-	-	-

Table 10-8

FIFTH DISTRICT (except for Chesapeake Bay) **SOLAR SIZING TABLE**

		TILT ANGLE											
B — BUOY	0°	LAMP SIZE											
S — STRUCTURE	60°												
FLASHER CHARACTERISTIC		.25A		.55A		.77A		1.15A		2.03A		3.05A	
		PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT
		WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS
FL4 (.4) or FL6 (.6)	B	10	100	10	100	10	100	20	100	35	100	35	400
	S	10	100	10	100	10	100	10	100	20	100	35	100
FL2.5 (.3)	B	10	100	10	100	20	100	20	100	35	200	-	-
	S	10	100	10	100	10	100	20	100	20	200	-	-
GP FL 8(2 + 1)	B	10	100	20	100	20	100	20	200	35	400	-	-
	S	10	100	10	100	10	100	20	100	35	100	-	-
GP FL5 (2x.4)	B	10	100	20	100	20	100	20	200	35	400	-	-
	S	10	100	10	100	10	100	20	100	35	100	35	500
IQKFL (8x.3)	B	10	100	20	100	20	100	35	100	35	700	-	-
	S	10	100	10	100	20	100	20	100	35	100	-	-
QKFL 1.0 (.3) or MO (A) (.4, 2.0)	B	10	100	20	200	35	100	35	400	-	-	-	-
	S	10	100	20	100	20	100	35	100	-	-	-	-
GP FL8 (2x1.0)	B	10	100	20	200	35	100	35	400	-	-	-	-
	S	10	100	20	100	20	100	35	100	-	-	-	-
E18 (3.0)	B	20	100	35	100	35	300	-	-	-	-	-	-
	S	10	100	20	100	35	100	35	200	-	-	-	-
OCC4 (3.0)	B	20	200	35	400	-	-	-	-	-	-	-	-
	S	20	100	35	100	35	200	-	-	-	-	-	-
FIXED	B	35	100	35	1000	-	-	-	-	-	-	-	-
	S	20	100	35	200	-	-	-	-	-	-	-	-

Table 10-9

FIFTH DISTRICT (Chesapeake Bay) **SOLAR SIZING TABLE**

TILT
 ANGLE

Reference Site: Washington, D.C.

B — BUOY		0'		LAMP SIZE									
S — STRUCTURE		60'											
FLASHER CHARACTERISTIC		.25A		.55A		.77A		1.15A		2.03A		3.05A	
		PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT
		WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS
FL4 (.4) or FL6 (.6)	B	10	100	10	100	20	100	20	100	35	100	35	600
	S	10	100	10	100	10	100	20	100	20	100	35	100
FL2.5 (.3)	B	10	100	10	100	20	100	20	200	35	300	—	—
	S	10	100	10	100	10	100	20	100	35	100	—	—
GP FL 6(2 + 1)	B	10	100	20	100	20	100	35	100	35	600	—	—
	S	10	100	10	100	10	200	20	100	35	100	—	—
GP FL5 (2x.4)	B	10	100	20	100	20	100	35	100	35	600	—	—
	S	10	100	10	100	20	100	20	100	35	100	—	—
IQKFL (6x.3)	B	10	100	20	100	20	200	35	100	—	—	—	—
	S	10	100	10	100	20	100	20	100	35	300	—	—
QKFL 1.0 (.3) or MO (A) (.4, 2.0)	B	20	100	35	100	35	200	35	600	—	—	—	—
	S	10	100	20	100	20	200	35	100	—	—	—	—
GP FL6 (2x1.0)	B	20	100	35	100	35	200	35	600	—	—	—	—
	S	10	100	20	100	20	200	35	100	—	—	—	—
E16 (3.0)	B	20	100	35	200	35	500	—	—	—	—	—	—
	S	10	200	20	200	35	100	35	600	—	—	—	—
OCC4 (3.0)	B	35	100	35	700	—	—	—	—	—	—	—	—
	S	20	100	35	100	35	600	—	—	—	—	—	—
FIXED	B	35	200	—	—	—	—	—	—	—	—	—	—
	S	20	200	35	400	—	—	—	—	—	—	—	—

Table 10-10

SEVENTH DISTRICT (except for GANTSEC) SOLAR SIZING TABLE

		TILT ANGLE											
B - BUOY	0°	LAMP SIZE											
S - STRUCTURE	60°												
FLASHER CHARACTERISTIC		.25A		.55A		.77A		1.15A		2.03A		3.05A	
		PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT
		WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS
FL4 (.4) or FL8 (.6)	B	10	100	10	100	10	100	20	100	35	100	35	200
	S	10	100	10	100	10	100	10	100	20	100	35	100
FL2.5 (.3)	B	10	100	10	100	10	200	20	100	35	100	-	-
	S	10	100	10	100	10	100	20	100	20	100	-	-
GP FL 6(2 + 1)	B	10	100	10	100	20	100	20	100	35	200	-	-
	S	10	100	10	100	10	100	20	100	35	100	-	-
GP FL5 (2x.4)	B	10	100	10	100	20	100	20	200	35	300	-	-
	S	10	100	10	100	10	100	20	100	35	100	35	400
IQKFL (6x.3)	B	10	100	10	200	20	100	20	200	35	500	-	-
	S	10	100	10	100	20	100	20	100	35	100	-	-
QKFL 1.0 (.3) or MO (A) (.4, 2.0)	B	10	100	20	100	35	100	35	300	-	-	-	-
	S	10	100	20	100	20	100	35	100	-	-	-	-
GP FL6 (2x1.0)	B	10	100	20	100	35	100	35	200	-	-	-	-
	S	10	100	20	100	20	100	35	100	-	-	-	-
E16 (3.0)	B	20	100	35	100	35	200	-	-	-	-	-	-
	S	10	100	20	100	35	100	35	200	-	-	-	-
OCC4 (3.0)	B	20	100	35	300	-	-	-	-	-	-	-	-
	S	20	100	35	100	35	200	-	-	-	-	-	-
FIXED	B	35	100	35	700	-	-	-	-	-	-	-	-
	S	20	100	35	100	-	-	-	-	-	-	-	-

Table 10-11

GANTSEC SOLAR SIZING TABLE

		TILT ANGLE											
B - BUOY	0°	LAMP SIZE											
S - STRUCTURE	30°												
FLASHER CHARACTERISTIC		.25A		.55A		.77A		1.15A		2.03A		3.05A	
		PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT
		WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS
FL4 (.4) or FL6 (.6)	B	10	100	10	100	10	100	10	100	20	100	35	100
	S	10	100	10	100	10	100	10	100	20	100	20	100
FL2.5 (.3)	B	10	100	10	100	10	100	10	100	20	100	-	-
	S	10	100	10	100	10	100	10	100	20	100	-	-
GP FL 6(2 + 1)	B	10	100	10	100	10	100	20	100	35	100	-	-
	S	10	100	10	100	10	100	20	100	20	100	-	-
GP FL5 (2x.4)	B	10	100	10	100	10	100	20	100	35	100	35	200
	S	10	100	10	100	10	100	20	100	20	100	35	100
IQKFL (6x.3)	B	10	100	10	100	10	100	20	100	35	100	-	-
	S	10	100	10	100	10	100	20	100	35	100	-	-
QKFL 1.0 (.3) or MO (A) (.4, 2.0)	B	10	100	20	100	20	100	35	100	35	800	-	-
	S	10	100	10	100	20	100	20	100	35	100	-	-
GP FL6 (2x1.0)	B	10	100	20	100	20	100	20	200	35	400	-	-
	S	10	100	10	100	20	100	20	100	35	100	-	-
E16 (3.0)	B	10	100	20	100	20	200	35	100	-	-	-	-
	S	10	100	20	100	20	100	35	100	-	-	-	-
OCC4 (3.0)	B	20	100	35	100	35	100	-	-	-	-	-	-
	S	10	100	20	100	35	100	-	-	-	-	-	-
FIXED	B	20	100	35	100	35	500	-	-	-	-	-	-
	S	20	100	35	100	35	100	-	-	-	-	-	-

Table 10-12

EIGHTH DISTRICT SOLAR SIZING TABLE

		TILT ANGLE											
B - BUOY	0°	LAMP SIZE											
S - STRUCTURE	60°												
FLASHER CHARACTERISTIC		.25A		.55A		.77A		1.15A		2.03A		3.05A	
		PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT
		WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS
FL4 (.4) or FL6 (.6)	B	10	100	10	100	10	100	20	100	20	200	35	200
	S	10	100	10	100	10	100	10	100	20	100	35	100
FL2.5 (.3)	B	10	100	10	100	10	100	20	100	35	100	-	-
	S	10	100	10	100	10	100	20	100	20	100	-	-
GP FL 8(2 + 1)	B	10	100	10	100	20	100	20	100	35	200	-	-
	S	10	100	10	100	10	100	20	100	35	100	-	-
GP FL5 (2x.4)	B	10	100	10	100	20	100	20	100	35	200	-	-
	S	10	100	10	100	10	100	20	100	35	100	-	-
IQKFL (6x.3)	B	10	100	10	100	20	100	20	200	35	400	-	-
	S	10	100	10	100	20	100	20	100	35	100	-	-
QKFL 1.0 (.3) or MO (A) (.4, 2.0)	B	10	100	20	100	20	200	35	200	-	-	-	-
	S	10	100	20	100	20	100	35	100	-	-	-	-
GP FL6 (2x1.0)	B	10	100	20	100	20	200	35	200	-	-	-	-
	S	10	100	20	100	20	100	35	100	-	-	-	-
E16 (3.0)	B	20	100	35	100	35	400	35	700	-	-	-	-
	S	10	100	20	100	35	100	35	100	-	-	-	-
OCC4 (3.0)	B	20	100	35	200	35	700	-	-	-	-	-	-
	S	20	100	35	100	35	100	-	-	-	-	-	-
FIXED	B	35	100	35	600	-	-	-	-	-	-	-	-
	S	20	100	35	100	-	-	-	-	-	-	-	-

Table 10-13

NINTH DISTRICT SOLAR SIZING TABLE

Except for:
Lake Superior
St. Marys River
Straits of Mackinac

TILT
ANGLE

Reference Site: Buffalo, NY

B - BUOY		LAMP SIZE													
S - STRUCTURE															
		.25A		.55A		.77A		1.15A		2.03A		3.05A			
FLASHER CHARACTERISTIC		PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT		
		WATTS	AMPHRE	WATTS	AMPHRE	WATTS	AMPHRE	WATTS	AMPHRE	WATTS	AMPHRE	WATTS	AMPHRE		
FL4 (.4) or FL6 (.6)	B	10	100	10	200	20	100	35	100	35	400	-	-		
	S	10	100	10	100	10	200	20	100	35	200	35	600		
FL2.5 (.3)	B	10	100	10	200	20	200	35	200	35	700	-	-		
	S	10	100	10	100	20	100	20	200	35	400	-	-		
GP FL 0(2 + 1)	B	10	100	20	100	35	100	35	300	35	1000	-	-		
	S	10	100	10	200	20	100	35	100	35	600	-	-		
GP FL5 (2x.4)	B	10	100	20	100	35	100	35	300	-	-	-	-		
	S	10	100	10	200	20	100	35	100	-	-	-	-		
IGKFL (6x.3)	B	10	100	20	200	35	200	35	400	-	-	-	-		
	S	10	100	20	100	20	200	35	100	-	-	-	-		
QKFL 1.0 (.3) or MO (A) (.4, 2.0)	B	20	100	35	200	35	500	-	-	-	-	-	-		
	S	10	200	35	100	35	200	35	700	-	-	-	-		
GP FL8 (2x1.0)	B	20	100	35	200	35	500	-	-	-	-	-	-		
	S	10	200	35	100	35	200	35	600	-	-	-	-		
E18 (3.0)	B	20	200	35	500	-	-	-	-	-	-	-	-		
	S	20	100	35	200	35	600	-	-	-	-	-	-		
OCC4 (3.0)	B	35	200	-	-	-	-	-	-	-	-	-	-		
	S	35	100	35	700	-	-	-	-	-	-	-	-		
FIXED	B	35	500	-	-	-	-	-	-	-	-	-	-		
	S	35	200	-	-	-	-	-	-	-	-	-	-		

Table 10-14

NINTH DISTRICT SOLAR SIZING TABLE

Lake Superior
ST. Marys River
Straits of Mackinac

TILT
ANGLE

Reference Site: Houghton, MI

B - BUOY		LAMP SIZE											
S - STRUCTURE													
FLASHER CHARACTERISTIC		.25A		.55A		.77A		1.15A		2.03A		3.05A	
		PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT
		WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS
FL4 (.4) or FL8 (.8)	B	10	100	20	100	20	200	35	200	35	600	-	-
	S	10	100	10	200	20	100	20	200	35	400	-	-
FL2.5 (.3)	B	10	100	20	200	35	100	35	300	-	-	-	-
	S	10	100	10	200	20	100	35	100	35	600	-	-
GP FL 6(2 + 1)	B	10	100	20	200	35	200	35	400	-	-	-	-
	S	10	100	20	100	20	200	35	200	35	900	-	-
GP FL5 (2x.4)	B	20	100	20	200	35	200	35	500	-	-	-	-
	S	10	100	20	100	20	200	35	300	-	-	-	-
ICKFL (6x.3)	B	20	100	35	100	35	300	35	600	-	-	-	-
	S	10	100	20	200	35	100	35	400	-	-	-	-
QKFL 1.0 (.3) or MO (A) (.4, 2.0)	B	20	200	35	400	35	700	-	-	-	-	-	-
	S	20	100	35	200	35	400	-	-	-	-	-	-
GP FL8 (2x1.0)	B	20	200	35	400	35	700	-	-	-	-	-	-
	S	20	100	35	200	35	400	-	-	-	-	-	-
E16 (3.0)	B	35	200	35	700	-	-	-	-	-	-	-	-
	S	20	200	35	400	35	800	-	-	-	-	-	-
OCC4 (3.0)	B	35	400	-	-	-	-	-	-	-	-	-	-
	S	35	200	-	-	-	-	-	-	-	-	-	-
FIXED	B	35	600	-	-	-	-	-	-	-	-	-	-
	S	35	400	-	-	-	-	-	-	-	-	-	-

Table 10-15

ELEVENTH DISTRICT SOLAR SIZING TABLE

		TILT ANGLE											
B — BUOY	0°	LAMP SIZE											
S — STRUCTURE	60°												
FLASHER CHARACTERISTIC		.25A		.55A		.77A		1.15A		2.03A		3.05A	
		PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT
		WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS
FL4 (.4) or FL6 (.6)	B	10	100	10	100	10	100	20	100	20	200	35	100
	S	10	100	10	100	10	100	10	100	20	100	20	100
FL2.5 (.3)	B	10	100	10	100	10	100	20	100	35	100	-	-
	S	10	100	10	100	10	100	10	100	20	100	-	-
GP FL 6(2 + 1)	B	10	100	10	100	20	100	20	100	35	100	-	-
	S	10	100	10	100	10	100	20	100	20	100	-	-
GP FL5 (2x.4)	B	10	100	10	100	20	100	20	100	35	100	-	-
	S	10	100	10	100	10	100	20	100	20	100	35	100
IQKFL (6x.3)	B	10	100	10	100	20	100	20	200	35	300	-	-
	S	10	100	10	100	10	100	20	100	35	100	-	-
QKFL 1.0 (.3) or MO (A) (.4, 2.0)	B	10	100	20	100	20	200	35	100	-	-	-	-
	S	10	100	10	200	20	100	20	200	35	500	-	-
GP FL6 (2x1.0)	B	10	100	20	100	20	200	35	100	-	-	-	-
	S	10	100	10	200	20	100	20	100	35	100	-	-
E16 (3.0)	B	20	100	20	200	35	100	35	600	-	-	-	-
	S	10	100	20	100	20	100	35	100	-	-	-	-
OCC4 (3.0)	B	20	100	35	100	35	600	-	-	-	-	-	-
	S	20	100	20	200	35	100	-	-	-	-	-	-
FIXED	B	20	200	35	500	-	-	-	-	-	-	-	-
	S	20	100	35	100	35	300	-	-	-	-	-	-

Table 10-16

TWELFTH DISTRICT SOLAR SIZING TABLE

		TILT ANGLE											
B — BUOY		0°											
S — STRUCTURE		60°											
FLASHER CHARACTERISTIC		LAMP SIZE											
		.25A		.55A		.77A		1.15A		2.03A		3.05A	
		PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT
		WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS
FL4 (.4) or FL6 (.6)	B	10	100	10	100	20	100	20	100	35	200	35	700
	S	10	100	10	100	10	100	10	200	20	100	35	100
FL2.5 (.3)	B	10	100	20	100	20	100	20	200	35	400	-	-
	S	10	100	10	100	10	100	20	100	35	100	-	-
GP FL 6(2 + 1)	B	10	100	20	100	20	100	35	100	35	700	-	-
	S	10	100	10	100	20	100	20	100	35	100	-	-
GP FL5 (2x.4)	B	10	100	20	100	20	100	35	100	35	700	-	-
	S	10	100	10	100	10	200	20	100	35	100	-	-
IQKFL (6x.3)	B	10	100	20	100	20	200	35	200	-	-	-	-
	S	10	100	10	100	20	100	20	100	35	300	-	-
QKFL 1.0 (.3) or MO (A) (.4, 2.0)	B	20	100	35	100	35	200	35	700	-	-	-	-
	S	10	100	20	100	20	200	35	100	-	-	-	-
GP FL6 (2x1.0)	B	20	100	35	100	35	200	35	700	-	-	-	-
	S	10	100	20	100	20	200	35	100	-	-	-	-
E16 (3.0)	B	20	100	35	300	35	600	-	-	-	-	-	-
	S	10	200	20	200	35	100	35	600	-	-	-	-
OCC4 (3.0)	B	35	100	35	700	-	-	-	-	-	-	-	-
	S	20	100	35	100	35	600	-	-	-	-	-	-
FIXED	B	35	200	-	-	-	-	-	-	-	-	-	-
	S	20	200	35	500	-	-	-	-	-	-	-	-

Table 10-17

THIRTEENTH DISTRICT (Coastal Regions)

SOLAR SIZING TABLE

		TILT ANGLE											
B - BUOY	0°	LAMP SIZE											
S - STRUCTURE	60°												
FLASHER CHARACTERISTIC		.25A		.55A		.77A		1.15A		2.03A		3.05A	
		PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT
		WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS
FL4 (.4) or FL6 (.6)	B	10	100	20	100	20	100	35	100	35	500	-	-
	S	10	100	10	100	10	200	20	100	35	100	35	600
FL2.5 (.3)	B	10	100	20	100	20	200	35	200	35	800	-	-
	S	10	100	10	100	20	100	20	200	35	300	-	-
GP FL 8(2 + 1)	B	10	100	20	200	35	100	35	300	-	-	-	-
	S	10	100	20	100	20	100	35	100	35	600	-	-
GP FL5 (2x.4)	B	10	100	20	200	35	100	35	300	-	-	-	-
	S	10	100	20	100	20	100	35	100	35	600	-	-
IQKFL (6x.3)	B	20	100	20	200	35	200	35	500	-	-	-	-
	S	10	100	20	100	20	200	35	100	-	-	-	-
QKFL 1.0 (.3) or MO (A) (.4, 2.0)	B	20	100	35	300	35	600	-	-	-	-	-	-
	S	10	200	20	200	35	200	35	600	-	-	-	-
GP FL6 (2x1.0)	B	20	100	35	300	35	500	-	-	-	-	-	-
	S	10	200	20	200	35	200	35	600	-	-	-	-
E16 (3.0)	B	35	100	35	600	-	-	-	-	-	-	-	-
	S	20	100	35	200	35	500	-	-	-	-	-	-
OCC4 (3.0)	B	35	300	-	-	-	-	-	-	-	-	-	-
	S	35	100	35	700	-	-	-	-	-	-	-	-
FIXED	B	35	500	-	-	-	-	-	-	-	-	-	-
	S	35	200	-	-	-	-	-	-	-	-	-	-

Table 10-18

THIRTEENTH DISTRICT (Puget Sound)

SOLAR SIZING TABLE

TILT
ANGLE

Reference Site: Seattle, WA

B - BUOY		LAMP SIZE											
S - STRUCTURE													
FLASHER CHARACTERISTIC		.25A		.55A		.77A		1.15A		2.03A		3.05A	
		PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT
		WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS
FL4 (.4) or FL6 (.6)	B	10	100	20	100	20	200	35	200	35	600	-	-
	S	10	100	10	100	20	100	20	200	35	300	35	800
FL2.5 (.3)	B	10	100	20	100	20	200	35	300	-	-	-	-
	S	10	100	20	100	20	100	35	100	35	500	-	-
GP FL 6(2 + 1)	B	10	100	20	200	35	200	35	400	-	-	-	-
	S	10	100	20	100	20	200	35	100	35	800	-	-
GP FL5 (2x.4)	B	20	100	35	100	35	200	35	400	-	-	-	-
	S	10	100	20	100	20	200	35	200	35	800	-	-
IQKFL (6x.3)	B	20	100	35	100	35	300	35	600	-	-	-	-
	S	10	100	20	100	20	200	35	300	-	-	-	-
QKFL 1.0 (.3) or MO (A) (.4, 2.0)	B	20	200	35	300	35	600	-	-	-	-	-	-
	S	20	100	35	100	35	300	35	800	-	-	-	-
GP FL6 (2x1.0)	B	20	200	35	300	35	600	-	-	-	-	-	-
	S	20	100	35	100	35	300	35	800	-	-	-	-
E16 (3.0)	B	35	200	35	700	-	-	-	-	-	-	-	-
	S	20	200	35	300	35	700	-	-	-	-	-	-
OCC4 (3.0)	B	35	400	-	-	-	-	-	-	-	-	-	-
	S	35	100	35	800	-	-	-	-	-	-	-	-
FIXED	B	35	600	-	-	-	-	-	-	-	-	-	-
	S	35	300	-	-	-	-	-	-	-	-	-	-

Table 10-19

THIRTEENTH DISTRICT (Eastern Half)

SOLAR SIZING TABLE

 TILT
ANGLE

Reference Site: Lewiston, ID

FLASHER CHARACTERISTIC		LAMP SIZE											
		.25A		.55A		.77A		1.15A		2.03A		3.05A	
		PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT
		WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS
FL4 (.4) or FL6 (.6)	B	10	100	10	200	20	100	35	100	35	400	-	-
	S	10	100	10	100	10	100	20	100	35	100	35	400
FL2.5 (.3)	B	10	100	10	200	20	200	35	200	35	700	-	-
	S	10	100	10	100	10	200	20	100	35	200	-	-
GP FL 6(2 + 1)	B	10	100	20	100	35	100	35	300	35	1000	-	-
	S	10	100	10	200	20	100	20	200	35	400	-	-
GP FL5 (2x.4)	B	10	100	20	200	35	100	35	300	-	-	-	-
	S	10	100	10	200	20	100	35	100	35	500	-	-
IQKFL (6x.3)	B	10	100	20	200	35	200	35	400	-	-	-	-
	S	10	100	10	200	20	100	35	100	-	-	-	-
QKFL 1.0 (.3) or MO (A) (.4, 2.0)	B	20	100	35	200	35	500	-	-	-	-	-	-
	S	10	100	20	200	35	100	35	500	-	-	-	-
GP FL6 (2x1.0)	B	20	100	35	200	35	500	-	-	-	-	-	-
	S	10	100	20	200	35	100	35	400	-	-	-	-
E16 (3.0)	B	20	200	35	500	-	-	-	-	-	-	-	-
	S	20	100	35	100	35	400	-	-	-	-	-	-
OCC4 (3.0)	B	35	300	-	-	-	-	-	-	-	-	-	-
	S	20	200	35	500	-	-	-	-	-	-	-	-
FIXED	B	35	400	-	-	-	-	-	-	-	-	-	-
	S	35	100	35	1000	-	-	-	-	-	-	-	-

Table 10-20

FOURTEENTH DISTRICT SOLAR SIZING TABLE

		TLT ANGLE											
B — BUOY		0°											
S — STRUCTURE		30°											
FLASHER CHARACTERISTIC		LAMP SIZE											
		.25A		.55A		.77A		1.15A		2.03A		3.05A	
		PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT
		WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS
FL4 (.4) or FL6 (.6)	B	10	100	10	100	10	100	10	100	20	100	35	100
	S	10	100	10	100	10	100	10	100	20	100	35	100
FL2.5 (.3)	B	10	100	10	100	10	100	20	100	20	200	-	-
	S	10	100	10	100	10	100	20	100	20	100	-	-
GP FL 8(2 + 1)	B	10	100	10	100	10	100	20	100	35	100	-	-
	S	10	100	10	100	10	100	20	100	35	100	-	-
GP FL5 (2x.4)	B	10	100	10	100	10	100	20	100	35	100	35	500
	S	10	100	10	100	10	100	20	100	35	100	35	100
IQKFL (6x.3)	B	10	100	10	100	20	100	20	100	35	100	-	-
	S	10	100	10	100	10	100	20	100	35	100	-	-
QKFL 1.0 (.3) or MO (A) (.4, 2.0)	B	10	100	20	100	20	100	35	100	-	-	-	-
	S	10	100	20	100	20	100	35	100	-	-	-	-
GP FL6 (2x1.0)	B	10	100	20	100	20	100	35	100	-	-	-	-
	S	10	100	20	100	20	100	35	100	-	-	-	-
E16 (3.0)	B	10	100	20	100	35	100	35	300	-	-	-	-
	S	10	100	20	100	20	200	35	100	-	-	-	-
OCC4 (3.0)	B	20	100	35	100	35	300	-	-	-	-	-	-
	S	20	100	35	100	35	100	-	-	-	-	-	-
FIXED	B	20	100	35	200	-	-	-	-	-	-	-	-
	S	20	100	35	100	-	-	-	-	-	-	-	-

Table 10-21

SEVENTEENTH DISTRICT (South Coast-Ketchikan to Adak)

SOLAR SIZING TABLE

		TILT ANGLE											
B - BUOY		0°											
S - STRUCTURE		75°											
FLASHER CHARACTERISTIC		LAMP SIZE											
		.25A		.55A		.77A		1.15A		2.03A		3.05A	
		PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT	PANL	BATT
		WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS	WATTS	AMPHRS
FL4 (.4) or FL8 (.6)	B	20	100	35	200	35	300	35	500	-	-	-	-
	S	10	100	20	100	20	200	35	100	35	500	-	-
FL2.5 (.3)	B	20	100	35	200	35	400	35	600	-	-	-	-
	S	10	100	20	100	20	200	35	200	-	-	-	-
GP FL 6(2 + 1)	B	20	200	35	300	35	500	35	800	-	-	-	-
	S	10	100	20	200	35	100	35	400	-	-	-	-
GP FL5 (2x.4)	B	20	200	35	300	35	500	-	-	-	-	-	-
	S	10	100	20	200	35	200	35	400	-	-	-	-
IQKFL (6x.3)	B	20	200	35	400	35	600	-	-	-	-	-	-
	S	20	100	20	200	35	200	35	500	-	-	-	-
QKFL 1.0 (.3) or MO (A) (.4, 2.0)	B	35	300	35	800	-	-	-	-	-	-	-	-
	S	20	200	35	300	35	600	-	-	-	-	-	-
GP FL6 (2x1.0)	B	35	300	35	800	-	-	-	-	-	-	-	-
	S	20	200	35	300	35	600	-	-	-	-	-	-
E16 (3.0)	B	35	500	-	-	-	-	-	-	-	-	-	-
	S	35	100	35	600	-	-	-	-	-	-	-	-
OCC4 (3.0)	B	35	800	-	-	-	-	-	-	-	-	-	-
	S	35	300	-	-	-	-	-	-	-	-	-	-
FIXED	B	-	-	-	-	-	-	-	-	-	-	-	-
	S	35	600	-	-	-	-	-	-	-	-	-	-

B. Preparation and Installation

Equipment Inspection. Prior to installation solar power equipment shall be inspected by the installing unit for defects and corrective action shall be taken in accordance with Table 10-22.

Solar Panels. Solar panels shall be stored in a clean, dry location. Although the solar panels have been designed by their manufacturer to be sufficiently rugged to withstand the normal dangers of aids to navigation service, they are not designed to withstand mishandling or abuse. Panels should be handled with care and must not be dropped or unnecessarily subjected to shocks or impacts. Solar panels shall be attached to mounting hardware using vandal-resistant nuts and installed in accordance with the instructions enclosed in the solar installation kits (NSN 5340-01-176-4179).

Voltage Regulators. Voltage regulators shall be stored in a clean, dry location. Regulators shall be attached inside standard lanterns on the CG-6P lampchanger mounting bracket above the CG-181 flasher. Installation and wiring instructions are included in the solar installation kits. It is possible to incorrectly mount the voltage regulators and throw off the focus on 155mm lanterns. Servicing personnel should insure that regulators are mounted properly according to the installation instructions.

Secondary Batteries

o Storage

1. Requirements--Batteries shall be stored upright in a clean, dry and cool location. Batteries shall not be in direct contact with a concrete surface and lead-acid batteries (such as those used for solar power) shall

never be stored with nickel-cadmium batteries. Extreme caution must be used when transporting or storing secondary batteries in the vicinity of primary batteries. The electrolyte of the primary batteries contains a strong alkali solution which, if accidentally combined with the acid electrolyte in the secondary batteries, can cause a violent thermal reaction. For this reason appropriate action shall be taken to prevent contact between primary and secondary batteries and their electrolyte solutions. Storage temperatures above 75°F severely affect shelf life and may cause premature failure of batteries. Batteries may be stored outside in an environmentally protected location not subject to high temperatures. The minimum storage temperature for secondary batteries should be above -20°F to avoid freezing. Never store metallic objects above a battery where they could fall upon and short out the terminals.

2. Shelf Life--Secondary batteries shall be used as soon as practicable after receipt. Batteries which have been in storage should normally be placed in use before newly received batteries. Every possible attempt shall be made to place batteries in service within one year of the date of manufacture. All secondary batteries in storage for more than one year and any battery showing signs of deterioration after storage shall be fully charged and bench tested prior to being put into service.

o Handling Batteries. Servicing personnel should take care to avoid contact with caustic electrolyte and should use eye protection and rubber gloves when handling batteries. When working around lead acid batteries, do not smoke, light a flame, or generate sparks with hand tools or electric tools since the battery may be venting

Table 10-22

Solar Power Equipment Inspection Requirements

<u>Equipment</u>	<u>Defect</u>	<u>Requirement</u>
Panels (10W, 20W, 35W)	Dirty	Clean glass
	Broken glass	Replace panel
	Missing wires	Replace panel
	No open circuit voltage	Replace panel
	Junction box cracked	Replace panel
	Stuffing tube cracked	Replace panel
Regulator	Not attached to mounting bracket	Replace regulator
	Missing wires	Replace regulator
Secondary Batteries	Battery case	
	Cracks	Replace battery
	Leakage	Replace battery
	Bulges, deformation	Replace battery
	Battery Terminals	
	Loose connections	Replace battery
	Corroded	Clean, tighten
	No lockwasher	Add lockwasher
	Low electrolyte level	Replace if 12V maintenance-free battery or add distilled water* if 6V battery.
	Low open circuit voltage upon receipt indicating less than 80% state of charge: 12V battery---12.5 Voc 6V battery---6.25 Voc	Recharge and bench test
	Shelf Life	
	Installation more than two months after date of manufacture	Recharge
	Date of manufacture more than one year old	Recharge and bench test
Installation Kits	Parts missing	Replace missing parts

*Note: Add distilled water only. Tap water or potable water will contaminate the electrolyte and cause premature failure.

Table 10-22 (Continued)

Solar Power Equipment Inspection Requirements

<u>Equipment</u>	<u>Defect</u>	<u>Requirement</u>
Mounting Hardware	Panel Hardware Appropriate panel does not mount properly (check <u>before</u> installation)	Modify or replace panel mounting hardware
	Structure stand Not compatible with particular structure to be attached to (check <u>before</u> installation)	Modify stand/base plate to make compatible.
	Battery racks 12V batteries do not fit (check before welding in place in buoys)	Replace rack
	Rack too large --- batteries not secured in rack	Use wedges or small pieces of wood to secure battery.

hydrogen gas which is highly explosive. When servicing 6V secondary batteries, particularly when disconnecting the battery terminals, loosen the battery filler caps completely but do not remove them. With the filler caps completely loosened, should a spark accidentally be generated to ignite the hydrogen gas, the unscrewed filler cap(s) would only blow off. If a spark occurred with the caps screwed down tightly, the battery would explode, possibly causing severe injury. Placing a dry rag over the loosened filler cap(s) will prevent acid spray should the filler cap(s) blow off. Do not lift batteries by the battery terminals. Always keep batteries in an upright position to avoid electrolyte spillage.

o Battery Charging

1. Requirements--Secondary batteries to be installed two or more months after the date of receipt shall be fully charged within one month of the anticipated installation date. Suspect batteries being bench tested must also be recharged. Servicing personnel shall follow manufacturer's instructions for battery charging.

Hydrogen gas is formed during the functioning of these wet cell storage batteries. Hydrogen gas is highly flammable, is much lighter than air, and will rise to the highest available space. Therefore, areas designated for service, storage, and charging of such batteries must be designed to:

- (a) Vent the gas to the exterior atmosphere, and
- (b) Prevent ignition of such gases which may not be completely vented.

2. Charging area requirements -- Floating units requiring battery charging shall have their batteries charged ashore or on deck prior to deployment. Appropriate interior spaces for charging batteries have not yet been identified - therefore, the charging of these batteries shall only

be conducted topside, where natural ventilation can occur, aboard floating units. Batteries should not be charged while underway except in emergency situations. In these rare cases, a maximum of four batteries can be charged at a time above deck when weather and sea conditions permit.

At shore units, battery charging may take place outdoors under natural ventilation where the climate and environment permit. An overhead shelter may be recommended to give protection from the elements. At shore units where battery charging cannot be accomplished outdoors, a small battery charging room must be provided meeting the requirements of NFPA 303, Chapter 4-10 (available from any District Safety Office). These requirements provide for venting the hydrogen gas to the outside atmosphere, preventing the ignition of any unvented gas, and other related precautions.

Ventilation requirements for battery charging rooms may be calculated as follows:

$$V = Cn (129)$$

where

C = battery capacity (Ah)

n = number of batteries

129 = liters/hr/Ah or
4.55 ft³/hr/Ah

Example: To charge ten 100-Ah batteries, what safe ventilation is required?

$$\begin{aligned} V &= 100 \text{ Ah} \times 10 \times \\ &\quad 4.55 \text{ ft}^3/\text{hr/Ah} \\ &= 4,550 \text{ ft}^3/\text{hr} \end{aligned}$$

Thus a room 10' x 10' x 8' would require ventilation providing at least 6 air changes an hour:

$$10' \times 10' \times 8' \times 6 = 4800 \text{ ft}^3/\text{hr}$$

The basic rules to be followed for eliminating hydrogen and other hazards from all charging of lead-acid batteries are:

(1) When not charging outside provide minimum ventilation in the amount of 129 liters/hour (4.55 ft³/hr) for each ampere-hour of rated capacity per each battery on charge. If ventilation is interrupted, do not resume charging until ventilation is restored.

(2) Smoking shall be prohibited in the charging area and NO SMOKING signs placed in the vicinity of batteries whether on charge, open circuit or discharge.

(3) Precautions shall be taken to prevent open flames, sparks or electric arcs in battery charging areas.

(4) When using tools near a battery be careful not to short out the battery terminals. Tools and other metallic objects shall be kept away from the top of uncovered batteries.

(5) When charging 6V batteries unscrew the vent caps and place them loosely in their openings. Tighten vent caps when finished charging.

(6) If racks are used for support of batteries being charged, they should be made of non-conductive materials or be coated or covered to prevent spark generation.

(7) The ambient temperature in the battery charging area shall not exceed 96°F.

(8) Use appropriate eye and skin protection when working with w batteries (see Personnel Safety).

(9) Material for neutralizing and flushing spilled electrolyte shall be provided in the charging area. Baking soda can be used to neutralize the acid of spilled electrolyte.

(10) Do not charge batteries in the vicinity of flammable liquids.

o Personnel Safety. Secondary batteries used by the Coast Guard for solar powered aids to navigation have been designed by their manufacturers to be sufficiently rugged to withstand the normal dangers of aids to navigation service. They are not, however, designed to withstand mishandling or abuse. All batteries should be handled with care and must not be dropped, thrown or unnecessarily subjected to shocks or impacts. The electrolyte used in lead-acid secondary batteries is sulfuric acid, an extremely-strong acid which is capable of causing painful skin burns and blindness if allowed to penetrate the eyes. To avoid electrolyte spillage, batteries should always be upright and never on their sides or upside down.

1. Personnel protective equipment--Personnel handling secondary batteries should always exercise caution to prevent contact between liquid electrolyte and the skin. Batteries being removed from service after several years in operation often leak electrolyte. It is mandatory that personnel charging secondary batteries wear rubber gloves, rubber aprons and boots and either chemical splash-proof goggles or full face shields. Personnel handling batteries being removed from service shall wear eye protection (full face shields and chemical splash-proof goggles are recommended) and rubber gloves.

2. Treatment for electrolyte burns--If lead-acid electrolyte comes in contact with the skin, the exposed area should be washed immediately with freely running water for at least fifteen minutes to dilute and wash away the caustic solution. Compresses of baking soda may be used on

electrolyte burns. Severe skin burns should be examined and treated by a doctor. Any chemical in the eye should be washed out immediately with large quantities of water. Chemical splashes in the eyes or face should be washed out at an emergency eye wash station provided in the battery charging room or area. Another way is to let the patient lie down; then gently pour cupful after cupful of water into the inner corner of the eye, letting it run to the other side. Continue this process for at least fifteen minutes. Then pour several drops of clean olive oil, mineral or castor oil into the eye. Cover with a sterile compress and get medical attention at once. Neutralizing solutions should not be placed in the eyes.

o Battery Installation. All batteries to be installed at one site shall be matched by date of manufacture or be recharged at the same time prior to installation. Batteries should be installed in a level, upright position to prevent premature battery failure. Wiring between the light and the batteries shall be made with standard type SO2, 12-AWG wire. After connections are made, a light coating of anti-corrosion agent, such as No-Oxide

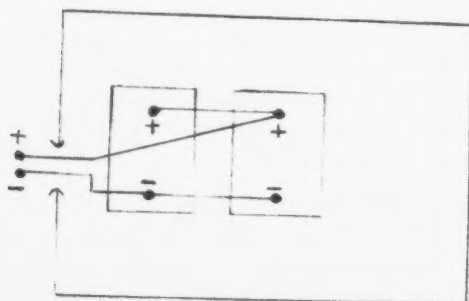


Figure 10-1. 200 Amp-hrs of 12V batteries in battery box.

Grease or Water Displacement Compound, shall be applied to each connection.

1. Structure Installation. The 6V or 12V maintenance-free batteries shall be installed within standard CG battery boxes as shown in Figures 10-1 and 10-2. Two 6V, 100 amp-hr batteries are connected in series to provide a 12V, 100 amp-hr package. The standard CG plastic battery box protects batteries from the elements and can hold four 12V maintenance-free batteries or six 6V batteries (300 amp-hr). Each battery box has built-in vents to provide adequate ventilation for the batteries. During installation ensure that all vents are clear. Chocking of batteries is required for structures subject to vibrations that could cause significant battery motion inside the battery box and lead to premature failure due to loosened connections.

Power systems requiring more than 100 amp-hrs will have a number of 12V, 100 amp-hr packages (12V batteries or two 6V batteries in series) connected in parallel to provide the proper storage capacity. For example an aid to navigation requiring 200 amp-hrs of capacity will have two 12V, 100 amp-hr packages connected in parallel as shown in Figures 10-1 and 10-2.

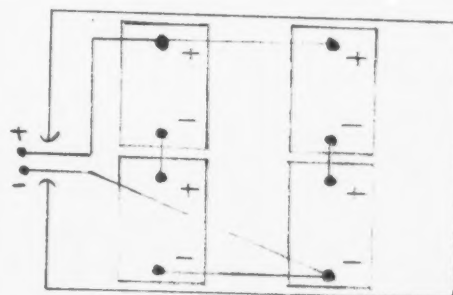


Figure 10-2. 200 Amp-hrs of 6V batteries in battery box.

2. Buoy Installation. Only 12V Maintenance-free batteries will be installed in the battery rack inside the battery pockets on buoys. Installation of secondary batteries into the battery rack in the buoy requires careful handling and as short a laydown time as possible to reduce the chances of electrolyte leakage. Batteries shall be installed with the axis of battery length parallel to the buoy tender deck and the battery vent facing up whenever possible to reduce electrolyte spillage. Power systems requiring more than 100 amp-hrs will have a number of 12V batteries connected in parallel to provide the proper storage capacity. Figure 10-3 shows 200 amp-hrs of 12V maintenance-free batteries installed in the battery rack inside the buoy battery pocket.

Buoy pockets are vented to allow air to circulate in the vicinity of

the batteries. Vent pipes must remain clear and free of obstructions to allow adequate ventilation. Precautions shall be taken to prevent open flames, sparks, electric arcs or smoking in the immediate vicinity of a buoy pocket containing secondary batteries, especially when it is first opened. If the vent pipes somehow become obstructed it is possible that hydrogen may collect in the top of the buoy pocket and present a temporary explosive hazard until the battery pocket cover is removed.

Battery pocket counterweights presently used to offset the weight of primary batteries may not be required once the buoy has been converted to solar power. Servicing units should evaluate the need for counterweights based upon the weight of secondary batteries to be used on each buoy.

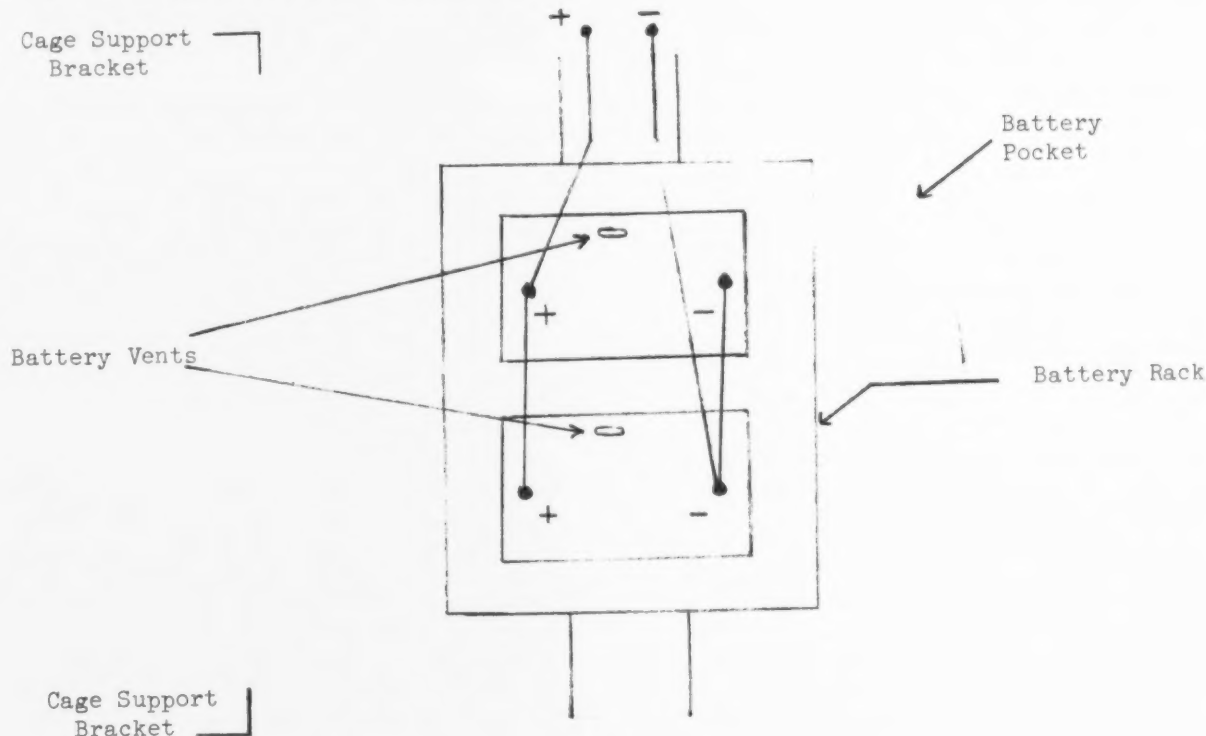


Figure 10-3. 200 Amp-hrs of 12V batteries installed in buoy.

C. Inspection, Maintenance and Repair

Solar Power System. Solar power systems on minor aids to navigation shall be inspected during the normal service visit to the aid and shall be serviced as indicated in Table 10-23. Details of how to perform the panel voltage check, functional check of voltage regulator, daylight control check, blocking diode check and battery load test are available in Aids to Navigation School publications. If servicing personnel find a discrepancy in the solar power system of an aid they shall complete the Solar Power Service Report (Form CG-5728) describing the problem. Solar panels, voltage regulators and batteries that require replacement shall be retained by the unit. Commandant (G-EOE) will provide disposition instructions for panels and regulators within fifteen (15) days of receipt of Form CG-5728 from the servicing unit. Secondary batteries replaced due to low voltage shall be bench tested and either returned to service or disposed of in accordance with the instructions provided in this sub-chapter.

Secondary Batteries

o Maintenance. Storage batteries are easy to maintain as long as you follow some fundamental guidelines. The next paragraphs contain instructions which should be strictly followed:

1. Keep the outside of the battery clean and dry. Always keep vent caps in place on 6V secondary batteries except when watering cells and charging. The 6V batteries should always be charged with the vent caps unscrewed and placed loosely in the opening (A dry rag placed over the vent caps will prevent acid spray should a spark occur and cause the vent caps to blow off).

2. Ammonia or baking soda can be used to neutralize the effects of spilled or sprayed acid if applied immediately. Be sure vent caps are screwed on tightly before applying ammonia or baking soda. Do not put neutralizing solution into the electrolyte.

3. Keep exposed flames away from the battery. Be sure all terminals are kept clean, tight, and coated with a corrosion preventive compound. A loose connection may easily cause an arc and burn off a post or cause an explosion, with possible injury to personnel.

4. Battery Posts are fragile. Care must be exercised when tightening lugs on a battery. Never over tighten connections at a battery post. A post may be partially fractured below the acid level without the fact being immediately noticeable. Do not use vandal-resistant nuts on battery posts.

5. Addition of acid--Never add acid solutions to the battery.

6. Watering--Keep the plates of 6V secondary batteries covered with solution. Do this by adding distilled water to the cells with a plain bulb syringe that has not been exposed to oil or other chemicals. When adding water do not put in too much. If a cell is accidentally filled too full, immediately withdraw solution to the proper level and flush the solution withdrawn (which may contain a diluted solution of acid) back into the battery distilled-water container. When adding water to a discharged 6V battery before charging add only enough water to cover the separators. After the battery is fully charged add additional water to bring the electrolyte to the proper level.

Table 10-23

On Station Inspection, Maintenance and Repair
of Solar Equipment

<u>Component</u>	<u>Action or Policy</u>
Solar Panel 10W, 20W and 35 Watt	Clean. Replace if glass is cracked or water is under the glass. Perform panel voltage check and replace if no voltage is measured when light is shining on panel
Battery, Lead Acid, 12V maintenance-free	Replace if case is cracked or bulging. If electrolyte is suspected to be spilled in the buoy battery pocket because of a cracked battery pour in baking soda to neutralize the acid solution. Check electrolyte level and replace the battery if low. Record voltage for voltage regulator check. Perform load test and replace if voltage is below 12.0 volts. Clean, tighten and grease terminals.
Battery, Lead Acid, 6V	Replace if case is cracked or bulging. Check electrolyte level. If necessary add distilled water. Record voltage for voltage regulator check. Perform load test and replace if voltage of the two 6V batteries in series is below 12.0 volts. Clean, tighten and grease terminals.
Voltage Regulator	Perform functional check of regulator. Perform daylight control and blocking diode checks. Replace if regulator fails any test (the voltage drop across the blocking diode should be 0.4-1.0 volts). Inspect wires from regulator to flasher. Replace regulator if wires are frayed or show signs of deterioration.

Table 10-23 (Continued)

On Station Inspection, Maintenance and Repair
of Solar Equipment

Wires/Cables	Visually check for fraying, deterioration or other damage. Replace damaged wires/cables. If solar panel cable is damaged replace panel.
Mounting and Support Hardware	Ensure that all clamps, screws, nuts, bolts and cable ties are tight and secure.
Bird Springs	Check to see that bird springs are correctly installed. Replace damaged or missing bird springs.

o Servicing. Secondary batteries used on solar powered aids to navigation shall be serviced as indicated in Table 10-23 and as recommended by battery manufacturer's instructions. These batteries shall be replaced after five years of service or when the load test voltage is less than 12.0V. The load test is performed by placing the standard battery load tester in the 3000 AH/Solar position (or a 13 ohm, 33 watt resistor) for at least ten minutes and then measuring the voltage. If the voltage is less than 12.0 volts the battery should be replaced and taken back to the unit for bench testing.

o Bench Test Procedure. The measured voltage of a secondary battery may fall below the minimum allowed value for several reasons other than battery failure. These reasons include incorrect wiring, failure of other electrical components or extensive guano or ice buildup on the solar panel reducing the panel's ability to recharge the battery. These batteries should be replaced at the aid, but they may be returned to useful service after being recharged if they pass the bench test procedure given below. This procedure should be performed at room temperature ($70^{\circ} \pm 15^{\circ}\text{F}$). Batteries should be kept at room temperature for at least 16 hours prior to testing.

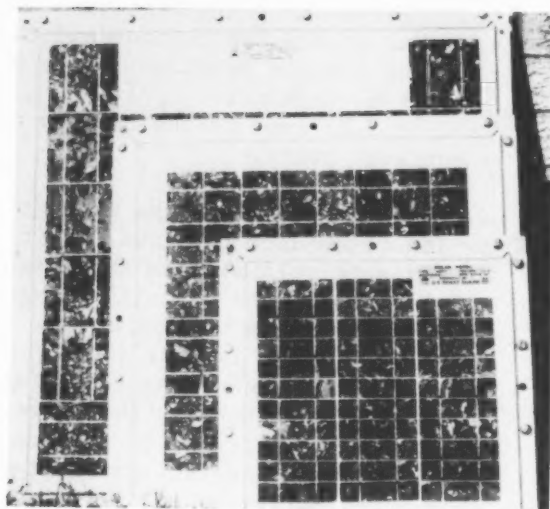
1. Recharge the battery to 100% state of charge according to the manufacturer's instructions.

2. Connect the battery directly to a lampchanger containing 2.03 amp lamps. Connect the positive battery terminal to the red (positive) terminal on the lampchanger and the negative battery terminal to the white (negative) terminal. Apply the fixed load of 2.03 amps to the battery for exactly 24 hours.

3. Immediately after the 24 hour period disconnect the load. Wait approximately 15 minutes and measure the battery's open circuit voltage with a calibrated voltmeter. If the measured voltage is less than 12.10V for 12V maintenance-free batteries or 6.08V for 6V batteries, the battery should not be returned to service. If the voltage is greater than stated above, the batteries may be placed in service after being fully recharged.

o Battery Disposal. Lead acid batteries can be salvaged for the scrap value of the lead they contain. Whenever feasible, batteries which are no longer serviceable shall be taken to a local salvage company to recover their scrap value. Funds recovered from this action shall be restored to the original appropriation charged in accordance with Vol. I, Part IV, Chapter 8 of the Comptroller Manual (COMDTINST M7300.4). Batteries that cannot be salvaged shall be disposed of according to EPA/State regulations as outlined in Chapter 9 of this manual.

SOLAR PANELS (10 watt, 20 watt, and 35 watt)



Function. The solar panels convert energy from the sun into electricity for recharging secondary batteries. Depending on the power requirements, an array may consist of any combination of the three size solar panels.

Features.

- o Semi-crystalline cells
- o Tempered glass cover
- o RTV silicone encapsulant
- o Anodized aluminum bezel and backplate
- o Potted and sealed junction box
- o High density black polyethylene cable

Electrical Characteristics. (under sunny conditions)

10 Watt Panel

Output voltage	15-19 Vdc
Output current	0.6A
Rated Power Output	8W
Weight (lb.)	7
Length/square side (in.)	16

20 Watt Panel

Output voltage	15-19 Vdc
Output current	1.3A
Rated Power Output	18W
Weight (lb.)	12
Length/square side (in.)	22

35 Watt Panel

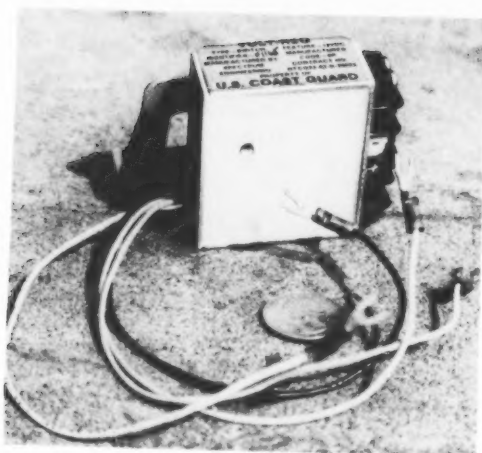
Output voltage	15-19 Vdc
Output current	2.2
Rated Power Output	32W
Weight (lb.)	22
Length/square side (in.)	28

Related Equipment. A voltage regulator and rechargeable battery are required to make up a solar photovoltaic system.

Additional Data. The manufacturer of the three size solar panels is Solarex Ventures Group of Solarex Corporation. Panels can be ordered in accordance with COMDTINST 10500.45 (series). Orders will be consolidated and panels will be shipped from Supply Center Brooklyn or directly from the manufacturer. The following national stock numbers apply:

10 WATT CG 5999-01-145-7152
20 WATT CG 5999-01-145-7153
35 WATT CG 5999-01-148-7879

12 Volt Switching Regulator



Function. The voltage regulator is a solid state device that prevents the battery from discharging through the panel(s) at night and provides a means for the solar panel to act as a daylight control.

Features.

- o Designed to fit inside standard lantern housings
- o Mounts on CG-6P lampchanger
- o Green Light Emitting Diode (L.E.D.) indicates trickle charge mode

Electrical Characteristics.

- o Input voltage range 12-19 volts
- o Maximum input power 70 watts
- o Typical output voltage 12-17 volts

Dimensions.

Width (in.)	2.5	Supported by a 3.5 in. wide bracket with 2 screw mounting cutouts.
High (in.)	2.25	
Deep (in.)	1.0	

Additional Data. The manufacturer of the voltage regulator is Spectrum Engineering of Florida. Regulators can be ordered in accordance with COMDTINST 10500.45 (series). Orders will be consolidated and regulators will be shipped from Supply Center Brooklyn or directly from the manufacturer. The below stock number applies:

NSN 6110-01-145-7155

12V Maintenance-free
Secondary Battery



Function. These 12V, 100Ah batteries may be used alone or connected in parallel to provide the proper current capacity as given in Tables 10-1 through 10-21 for solar power systems used on buoys and fixed aids to navigation.

Features.

- o Fully charged prior to shipment
- o Designed specifically for photovoltaic applications
- o Designed to prevent electrolyte spillage. Sealed to prevent electrolyte contamination.

- o Visible means of determining if battery is at a low state of charge
- o Visible means of checking the electrolyte level
- o Electrolyte freezing temperature at 50% state of charge: -4°F
- o Stud type stainless steel $3/8$ -in. positive and negative cell terminals
- o Maximum shelf life - 1 yr.
- o Maximum service life - 5 yrs.

Electrical Characteristics.

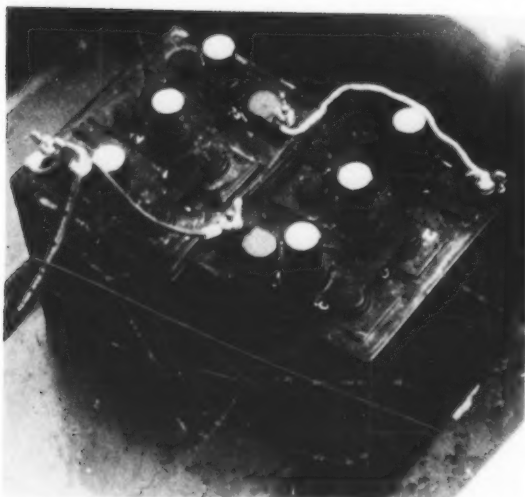
Output Voltage	12-15V
Capacity at 100-hr. discharge rate	105 Ah

Dimensions and Weight.

Weight (lb)	60
Height (in)	9-3/8
Width (in)	6-3/4
Length (in)	13

Additional Data. The 12V maintenance-free battery to be used on solar power systems for aids to navigation is manufactured by Delco Remy Division of General Motors, 2401 Columbus Avenue, Anderson, Indiana 46011. Batteries can be ordered directly from the manufacturer on the latest term contract, copies of which are available from Commandant (G-FCP-2).

6V Secondary Batteries
(Exide 3-DD-3)



Function. Two 6V, 100 Ah batteries may be connected in series to provide a 12V, 100Ah electrical package. These electrical packages of two batteries in series can then be connected in parallel to provide the proper current capacity as given in Tables 10-1 through 10-21 for solar power systems used on fixed aids to navigation. These batteries are not used on buoys due to leakage of electrolyte.

Features.

- o Fully charged prior to shipment
- o Allows addition of distilled water if electrolyte level is low

- o Excellent cold weather battery. Electrolyte freezing temperature at 50% state of charge: -20°F
- o Wing nut bolt connectors (1/4" - 20)
- o Maximum shelf life - 1 yr.
- o Maximum service life - 5 yrs.

Electrical Characteristics.

Output voltage	12-15V
Capacity at 100-hr. discharge rate	100 Ah

Dimensions and Weight.

Weight (lb)	40
Height (in)	9-5/8
Width (in)	6-3/4
Length (in)	8-1/2

Additional Data. The manufacturer of the 3-DD-3 secondary battery is Exide Corporation, 9176 Red Branch Road, Columbia, Maryland 21045. Batteries should be ordered from the manufacturer on the latest GSA schedule. Use the below part number when ordering:

<u>Type</u>	<u>Part Number</u>
3-DD-3	04825

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